SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXX.—No. 19.] ESTABLISHED 1845. NEW YORK, MAY 13, 1899. [$3.00 A YEAR. WEEKLY.

ELECTRIC SURREY IN OPERATION.

ELECTRIC SURREY CONSTRUCTED ON "THE RIKER SYSTEM," SHOWING DETAILS OF WORKING PARTS.—[See page 295.]

Scientific American.

ESTABLISHED 1845.

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS.

One copy, one year, for the United States, Canada, or Mexico......... $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845).............................$3.00 a year.
Scientific American Supplement (Established 1876)............... 5.00 "
Scientific American Building Edition (Established 1885)........ 2.50 "
Scientific American Export Edition (Established 1878)........... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, MAY 13, 1899.

THE CHARM OF THE BICYCLE.

The philosophers tell us that one of the most powerful motives that govern human life is the love of power; that the exercise of power, showing itself in some visible effect, is accompanied with pleasurable emotion, and that the degree of pleasure depends upon the smallness of the effort compared with the magnitude of the effect. It is claimed that this love of producing effect shows itself at the very threshold of life in the preference of the infant for toys that produce sounds or exhibit motions, and it is probably because the result is so disproportionate to the effort that the boy finds unalloyed delight in the noise of a drum or the screech of a tin horn.

The same philosophy tells us that the politician, the soldier, the leaders in the world of finance, and, indeed, all men who exert a powerful influence upon the destiny of their fellows, are consciously or unconsciously actuated to a large degree by the same passion for producing effect, and producing large effect with the smallest expenditure of effort. Certain it is, that the delight with which we contemplate achieved success is always heightened if that success has been won with a disproportionate effort or loss. The victories of Manila and Santiago, great as they were in themselves, take on a special glory from the fact that in those two conflicts we destroyed a navy and won an empire with practically no hurt to ourselves. Our successful invasion of foreign markets has aroused the national enthusiasm, not merely because it means increased trade and enhanced prosperity, but because the extraordinary ease with which, at the first attempt, we have captured these foreign markets, appeals to our sense of power and testifies to the latent energy of the race.

But coming a little closer to our subject, we find that in the world of sport, and especially among those devotees who are entitled to the designation of true sportsmen, this love of power and the desire to perform exceptional feats of skill and endurance with the least expenditure of visible effort, is the supreme motive. Indeed, we doubt if any surer test of the quality of an amateur sportsman can be found than the degree in which he is actuated by this spirit to the exclusion, or rather the subordination, of all other motives. The ideal sportsman engages in combats of strength and skill, not with a view of capturing some reward in the shape of money, jewelry, or medals, not merely for the pleasure of "downing" his opponent, not alone for the grand stand applause—although all of these are perfectly proper motives in their place and degree. The ideal sportsman is he who aims to break the record first and last for the sake of the sport itself, and who finds his highest reward in the contemplation of the fact that the mark (whatever it may be) has been placed so much higher with so much greater ease (if such be the case) than ever before. The delight of the audience is always greater if the winning horse come in without the incentive of whip and spur, or if the popular sprinter cross the tape watching his beaten opponent over his shoulder, or if the champion cyclist of the year sweeps through the "bunch" from the rear and "sits up," an easy winner, a yard or two before the tape is reached.

Looking at the active sports as a whole, it will be found that their relative popularity is largely determined by the degree of skill, the swiftness of motion accomplished in proportion to the smallness of the effort that must be exerted. Hence the enormous and sudden popularity of certain games over others. Note the sudden extinction of the amiable, but imbecile game of croquet, by the swifter game of lawn tennis, and this, in turn, by golf, with its far-reaching links and its "drives," measured by the hundreds of yards.

It is when we consider the modern pastime of bicycling, however, that we meet with the most striking exhibition of the strength of this desire to do much and do it with comparatively little effort. It is because the bicycle enables us to travel so far afield with such an astonishingly small expenditure of effort that it has achieved its sudden and world-wide popularity. Of course, there are other contributory causes, such as the desire for exercise; the opportunity given to those who cannot afford to keep a carriage to get out into the scenes and sweet air of the country; and to many people the saving of time and expense in transacting their daily business; but these considerations alone do not account probably for one-tenth of the millions of people who day by day and week by week are to be found reeling off the miles with a persistence which might make one suppose that wheeling was as necessary a part of their existence as breathing or the circulation of the blood—and to not a few of them, indeed, it is as necessary.

Fresh air, green fields, the song of birds, the ever-changing panorama of the countryside, the quickened sensibilities of mind and body all are accessory pleasures of the wheel; but the deep, underlying charm of it all is the sense of achieving this swift motion at as little expenditure of effort as would be necessary in walking for half a dozen blocks in a city thoroughfare. Who will ever forget his first bona fide country ride on a good level road, undertaken as soon as the problems of equilibrium had been mastered, and the thrill of exultation with which he found that the same muscular effort which moved him at three miles an hour on his legs, is now sufficient to carry him at twelve miles an hour on his wheel. The result seems so absurdly disproportioned to the effort, as to create a half belief that one's own physical strength must have redoubled. Certain it is that one's sense of power is most pleasurably affected, and the persistent protest of the mind against the inertia of things material is silenced for the while.

And, after all, speaking of the inertia of things, the bicycle is only one expression of the great world-struggle of mind to overcome the inertia of matter.

The history of the arts and sciences, and especially of those which concern travel and intercommunication, is the history of man's successful effort to set in motion the latent energies, the inert masses of nature, and hence there is a strict relation between the development of transportation and the growth of our material wealth and comfort. The craze for "breaking the record," whether it be on the train, the steamship, or the wheel, is prompted by something more than the mere love of the spectacular; for the world recognizes that every new performance is a further breaking away from that universal stagnation in which all matter lay before its present evolution began—a stagnation which it is the constant effort of our modern arts and sciences to overcome.

RECORDS OF SPEED AND ENDURANCE ON THE BICYCLE.

Although the great majority of riders are content to travel at a comfortable speed of from 8 to 10 miles an hour, and have neither the inclination nor the ability to ride faster for any length of time, the great crowds that witness the trials of speed and endurance, week by week during the racing season, testify to the fact that the riding public is deeply interested in the possibilities of speed and endurance on the bicycle as shown by the racing cyclist. The racing enthusiast is well versed in the standing of the records for various distances and times, and carries them, indeed, at his fingers' ends; but there are many riders to whom a statement of what has actually been achieved would come with a shock of surprise. We are all aware that some phenomenal speeds have been recorded, but there are probably few who appreciate the fact that a mile has been ridden on the track at the rate of between 39 and 40 miles an hour, or that a rider has covered 34¼ miles in a single hour, or that yet another has rolled off 616 miles in a single day, or that—perhaps most wonderful of all—a fourth rider has ridden over 2,100 miles in the space of six days, while a fifth has traveled two hundred and fifty consecutive centuries on as many consecutive days, thus covering 25,000 miles in a little over eight months of the year.

The full meaning of these figures can best be realized by comparison. A mile in 1 minute 31⅖ seconds, as made by Taylor at Philadelphia, is just under 40 miles an hour, which is as fast as or faster than the scheduled running time, including stops, of many of the crack expresses between New York and Chicago. Compare Elke's feat of riding 34¼ miles in an hour at Philadelphia with the speed of the so-called local express trains out of this city. It means that, if a suitable track were laid down to some outlying town 30 or 40 miles from New York, the rider in question could start for home in the evening at the same hour as the train and reach his destination several minutes earlier than he could on the cars. On September 16, 1897, Cordang rode for 24 hours at an average speed of 25·7 miles an hour, covering a total distance of over 616 miles. One extraordinary feature of this performance was the fact that the pace was faster during the twenty-fourth than during the first hour, and that after the rider had covered 600 miles, he was riding the mile in 1 minute and 56 seconds and 1 minute and 57 seconds, or at the rate of 31 miles an hour. Applying these figures to actual railroad traveling, we find that there are even to-day continuous 600 mile journeys which the traveler will take over 24 hours to complete. If a special track could be laid for the purpose, the same speed would carry a rider from New York to Richmond and back in a single day. Perhaps the most wonderful feat of long distance traveling on record is the ride of Miller made during the winter at San Francisco, when he covered over 2,100 miles in six days of continuous riding. This would be equivalent to riding from San Francisco to Chicago, or over two-thirds of the distance across the continent, in a week, and having one day of the seven for rest at the journey's end. Finally, we have the 25,000 mile ride of Edwards, who, starting on the first day of January, 1898, rode a century every day of the year up to the 7th of September, thus covering a total distance greater than the circumference of the globe in only about 30 per cent more actual riding time than that allowed by Jules Verne for a record trip around the world.

The mile record was made on a chainless wheel of the Sager type geared to 114. The hour, the 24-hour, and the 6-day records were made on chain wheels with gears varying from 96 to 112. The 25,000 mile ride was made on a chainless wheel of the bevel gear type, the same wheel being used throughout and in every kind of weather. The fact that the gears, though worn, were in good working order testifies to the durability of this type of driving mechanism.

These are records as they stand to-day. It must be understood, of course, that the mile, hour, and all-day records were made behind pacing machines. The present season is likely to see the introduction of motor pacing, and we may look for an extensive reduction of these records, remarkable as they are.

OUR SEA-COAST DEFENSES.

A few years ago the country was greatly disturbed over the fact that it had no sea-coast defenses. Now it appears that while we have the defenses, we lack efficiency in the care and handling of the guns. Such, at least, is the burden of a report recently made upon the subject by Captain William Crozier, his complaints being based upon what he saw during a tour of inspection made last November. The matter can best be stated in the Captain's own words:

"I have found in many cases that neither the officers nor men understood or attentively looked after the armament. I have many times had difficulty in getting guns, and especially carriages, properly cleaned for firing test. . . . The officers seem to be without proper standards of performance, and almost no attention was paid to rapidity of fire. . . . When it came to the actual firing of pieces, all efforts at lively work were often abandoned. There has been thus far great neglect of the subject of the pointing of mortars; some batteries which have been completed for years have been during the late war and are now absolutely unserviceable because of inability to point the mortars at a target." The report attributes this lack of interest to the long neglect of the subject during the twenty years following the civil war and to the lack of a liberal policy in the management of artillery matters, particularly in the opportunities for actual practice in loading and firing guns. He suggests, as one important remedy, that there should be on the staff of the commander of the army a chief inspector of artillery, who should make periodical inspections to see that the various orders respecting the details of artillery service are faithfully carried out.

This report will come as a painful surprise, for it shows that we are backward in a service which we thought was being brought up to a state of considerable efficiency. The two defects of slowness of fire and absence of range finders are about as serious as they could well be. Modern warships will try to run by the batteries, and their high speed will carry them through the danger zone very quickly. Vessels that can make a mile in less than three minutes will be a difficult target for guns which (because of slow handling) can fire but one shot in every six minutes. Next to accuracy, rapidity is the great desideratum in a gun detachment.

Mortars sunk in deep pits, with nothing to look at but the blue sky above, are absolutely dependent on distant range finders for locating the enemy, and giving the proper elevation and traverse for the mortar, and a battery of mortars without means for pointing is as useless as a rifle in the hands of a blind man.

It is to be hoped that immediate steps will be taken to reform the abuses which have been so faithfully exposed in this report. It is to the author of this report and to Colonel Buffington, Chief of Ordnance, that we owe much of the excellent material to be found in our defenses, and we trust that under the present regime this important arm of the service will be brought up to the standard, in personnel as well as material, of the best modern practice.

THE FASTEST CRUISER IN THE WORLD.

It seems ridiculous that the nation that is least able to make use of them should possess the fastest torpedo boat and the fastest cruiser in the world. The famous Schichau firm recently built a torpedo boat for China which made 35·2 knots per hour, and now the Armstrongs have completed a 4,400-ton cruiser, the "Hai Tien," which has made a natural draft speed of 22·6 knots and a forced draft speed of 24·1 knots per hour. This is the record for a warship, or, indeed, for any kind of ship of that size. If the "Hai Tien" could maintain that speed across the Atlantic, she would make the passage in about four days and a half.

AUTOMOBILISM IN PARIS.

Great strides have been made in the world of automobiles within the last eight years. In 1890 Messrs. Serpollet and Archdeacon attempted the journey from Paris to Lyons. The difficulties they encountered from the very commencement were enormous and such as would very soon discourage any automobilist of the present day. Endowed as they were with a more than ordinary degree of perseverance and patience, they succeeded in effecting the journey in the time of ten days! In very truth, "tempora mutantur." Now the distance can be made in as many hours.

In any account of present day automobilism, the name of M. Pierre Giffard, the director of the Velo, and formerly on the staff of the Petit Journal, must be mentioned. Four years ago carriages with mechanical motors were practically unknown. At this time M. Giffard commenced a war against the prejudices of the public on this subject, and with the patronage of the Petit Journal, organized in 1894 the first great automobile race ever witnessed, from Paris to Rouen. Great excitement was manifested as to the issue of the race, and speculations were made as to the relative merits of steam and petroleum. The Count de Dion competed with a steam motor (see the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1080 and 1182), while Messrs. Levassor and Peugeot opposed him with petroleum-driven machines (shown in the SCIENTIFIC AMERICAN for July 20, 1895). Ten competitors appeared at the starting point at Neuilly. According to the regulations, it was not only the speed that would be considered by the judges in awarding the prize; the flexibility and power of endurance of the machines would also receive due allowance.

The race took place, and though the steam-driven machine came in easily first, the prize was not allotted to it alone. Messrs. Levassor and Peugeot were classed as winners on the same level as M. de Dion, and the future of the petroleum-driven motor car was assured. Qualities essentially practical were discovered in it, and the fact that any one, not necessarily an engineer, could steer and manage it, was sufficient assurance of the success it was destined to attain. The race is illustrated and described in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 979.

Six months later, at the exhibition of the Salon du Cycle, held in the Palais de l'Industrie, automobile carriages were permitted to appear; the crowd collected round these innovations in steam and petroleum, their interest in the bicycle stands being considerably diminished in favor of these novelties.

The following year it was felt that another race must be run, but this time no conditions should be laid which would leave in doubt the real merit of the different machines. Speed alone should decide the race and the whole unrestricted power of the motors should be exhibited.

The route decided upon was Paris to Bordeaux and back. Subscriptions rolled in, and one hundred thousand francs were quickly raised to meet the organization expenses and to pay for the prizes.

The advocates of steam for motors do not give in. Messrs. de Dion, Serpollet, and Bollée engage actively in the construction of machines which they hope will show to the world its superiority over petroleum.

The advocates of the latter, however, also prepare for an exploit which will, they feel confident, bring confusion and defeat on their rivals.

Electricity as a motor is also taken up by M. Jeantand (see the SCIENTIFIC AMERICAN for March 23, 1895), who, at considerable expense, obtains a special train to place at periodical stages of the journey between Paris and Bordeaux fresh accumulators, etc., which his carriage is to take up on the way.

On June 10 the automobiles assembled at the Arc de Triomphe, in the presence of an enormous crowd. From there they went, at a moderate pace, to Versailles, where the real start was given. A few kilometers farther on the steam atomobiles come to grief. Twelve hours pass, when news arrives that M. Levassor, on his petroleum auto-car, is an hour and a half ahead of his rivals. Twenty-four hours pass, and already he has reached Bordeaux and is back on the return journey to Paris, crossing his rivals on the road with an advance of four hours. No sign of fatigue either in man or machine can be seen. Porte Maillot is reached at last, the whole distance of 1,200 kilometers having been run in 48 hours 47 minutes. (See the account of the race published in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1023.) Signal victory for the petroleum motor. The 1895 race bore fruit immediately. A great project had long been resolved upon in his mind by the Count de Dion to found a club for the defense and encouragement of automobile riding—to create the Automobile Club of France. The race from Paris to Marseilles in 1897 was a great success, and is described in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1096.

At the present date automobiles form an important element in the circulation of our towns. Nowhere are they more popular than in Paris; nowhere is any real progress, any fresh idea, likely to receive encouragement so much as there. Every morning the Champs Elysées, the Bois de Boulogne, and the avenues branching off from the Arc de Triomphe are alive with these horseless carriages of all kinds and traveling at a speed far surpassing that of any rival vehicle. Especially on Sundays may they be seen to best advantage in this aristocratic quarter of Paris; in fact, the number of automobilists and cyclists seems to surpass the number of the pedestrians.

No sooner had the automobile been acknowledged to be a practical thing than the bicyclists themselves were the very first to become its votaries. Naturally they were already accustomed to the dangers of the roads and thus cut out to become excellent "chauffeurs;" in fact, it was through them that the automobile was first introduced to the public.

The best known cyclists quickly mastered all the details connected with the new sport and became trainers of the aristocracy, who so eagerly took up the new sport. René de Kuyff had the Prince of Wales as his pupil, while Lambajack, the famous tandemist, gave lessons to the Duchesse d'Uzès.

But if the automobile were to remain the exclusive property of the wealthy, and of those favored by fortune, it would never obtain the popular favor without which its success would not be assured. So that the question may be asked: Can an automobile be bought nowadays in full confidence? Will not the prices lower? The fact is that those who bought machines two years ago have gained small fortunes. The best constructors not being in a position for the last two years to deliver a machine ordered in a shorter time than eighteen months after the order had been given, it may easily be understood that a machine from the same firm, bought on the spot, has a far greater marketable value. A carriage ordered at the price of nine thousand francs in eighteen months is readily sold for eighteen thousand francs, payable at the present time. So that the speculation consists in immediately ordering carriages at catalogue price and selling them the day they are delivered for some thousands of francs more than they have cost one. Hence, from a pecuniary point of view, no loss may be feared in purchasing a machine from a reputable firm; one would, indeed, be more likely to gain than to lose. An automobile, however, should not be bought without taking the advice of a disinterested specialist.

Automobiles in actual use may be divided into three classes. First, motocycles; second, carriages; third, heavy luggage vehicles.

First.—The motocycle is a cycle furnished with a mechanical motor, often supplied with ball bearings, tube frames, pneumatic tires, etc., in fact, it is more of a cycle than a carriage.

The best known is that of the firm De Dion et Bouton, the "tricycle à pétrole," which has been in existence three years. The motor is vertical and is placed in the rear, while the explosive mixture is lit by an electric spark, so that besides the petroleum apparatus a galvanic battery, etc., must be carried. The working of the driving and steering arrangement is mere child's play and can be learned in half an hour.

The great advantage of De Dion's machine is its relative cheapness and the small amount of care and attention it necessitates.

The serious defect, in the opinion of many, of the petroleum tricycle is that there is only one seat. The simplest remedy to this is to convert the simple tricycle into a tandem tricycle by lengthening the frame. This only increases the weight by 3 or 4 kilos., the only inconvenience now being that the tricycle cannot be reduced to a machine with only one seat when only one rider wishes to mount it.

The most generally adopted solution is that of the "towing-carriage," the tricycle serving as traction motor, while an iron bar is attached to the shaft of a small spring carriage with pneumatic wheels in which two persons may be seated. Average hills are readily mounted, while a slight amount of pedaling is all that is needed during a steep ascent.

This motor of the firm De Dion et Bouton has had an enormous success and has been applied in numerous ways. With it there have been provided automobile bicycles, quadricycles, and even boats.

Another vehicle, the Bolleé (see the SCIENTIFIC AMERICAN for October 17, 1890), is in the first rank of motocycles. This is a long machine, very low and stable, with two seats, the lady seated in front, the gentleman behind, steering. This is also a tricycle, but with the direction effected by the two wheels, which are in front, and the propulsion only by one in place of two. The lighting is obtained by an incandescent tube. This is a very rapid machine and a very fine hill climber. Only a few months ago, during the "Criterium des motocycles," which took place from Etampes to Chartres, a "Bollée" automobile with double motor of 8 horse power, mounted by M. Leon Bollée, the inventor, accomplished the distance of 100 kilometers in 1 hour 52 minutes, i. e., at an average pace of 51 kilometers an hour! This is the world's record for that distance for any kind of road machine whatever.

The price of motocycles is comparatively moderate and ranges between 1,000 and 3,000 francs. The fortune of the automobile certainly depends on the progress attained by this class.

Second.—The class of carriages is represented by a more considerable number of builders. Here the motors are more powerful, while the framework of the machine is as comfortable as an ordinary carriage. It is capable too of all the movements required of it if harnessed to a horse, while it may be specially noticed that a retrograde movement is possible, which cannot be said of the motocycle.

The weight of the carriages of this second class varies considerably. Generally a carriage with two seats with a motor of approximately 3 horse power weighs about 400 kilos. For four places and 6 horse power it may weigh between 700 and 800 kilos. The weight diminishes, however, day by day in proportion to the improvements in manufacture. The firm Panhard & Levassor is the most important in this class. Its principal rival is Peugeot, a firm which won the demonstration races from Paris to Rouen and Paris to Bordeaux in 1894 and 1895 respectively.

Petroleum is used by all the models in this class, though there are not lacking defenders of steam as a motive power.

M. Serpollet, the constructor of the Serpollet trams circulating in Paris, has brought out apparatus which seem as though they would finally give steam the superiority. These new types comprise very light generators, the heating of which is effected by petroleum burners, which give a flame great in proportion to the quantity of water to be converted into steam. The pressure of these burners varies between 50 grammes and 3 kilos., thus bringing into instantaneous equilibrium the effort of the motor and the resistance of the road.

The motor used on these carriages is of an entirely new system, requiring no care so far as oiling is concerned, so that steam may again speedily become a formidable rival to petroleum. The carriage is illustrated in the SCIENTIFIC AMERICAN for February 21, 1891.

Electricity, too, has made its "debut" in locomotion. An almost perfect electric motor has been found. Backward and forward motion, and excellent brake arrangement, by the play of a simple commutator placed under the driver's hand, absence of noise, smell, or vibration, are only a few of the qualities of this wonderful motor.

It has only one fault, an immense quantity of electricity is wanted. Special accumulators, the charging of which is slow, though their emptying is rapid enough, have to be taken up. These accumulators are very heavy; 400 or 500 kilos. of them are required for a carriage in advancing 60 kilometers. Then they have to be refilled at the works. Accordingly, electric carriages can only be employed within a small radius of these works, from which the supply of energy is obtained. Still, they seem to be destined for a great future in town locomotion by reason of the ease with which accumulators may be obtained.

Third.—The third class of automobiles, public or heavyweight carriages, is necessarily restricted. They are all moved by steam. A curiosity may be mentioned, the automobile rolling house. When small, and arranged for two persons only, a petroleum motor of 12 horse power drags it along at the rate of 15 kilometers an hour. When large and containing a regular apartment for two couples and four servants, a steam motor of 35 horse power is required, though it is not safe to travel at a faster rate than 8 kilometers per hour.

Special police regulations are necessarily required, and it is found that the only regulation to-day applicable to automobile locomotion dates from 1893, at a period when the automobile, such as it appears now, was practically non-existent. According to this law, the pace ought not to exceed 8 kilometers per hour (the average speed of automobiles is 45 kilometers), the minimum for an ordinary cab.

The "chauffeur" is not permitted to leave, even for a moment, his automobile along the curb of the footpath, unless under supervision. Now, the automobile, once the motive power is turned off, cannot gallop away like a horse. To be just, a limit of speed, difficult to fix upon though it be, ought to be imposed on all kinds of mechanical carriages, as well those which now seem to enjoy a monopoly of speed as on the inoffensive automobile.

Another thorny question: Is the automobile dangerous to foot passengers? The compact mass of the iron steed rushing along at a great speed is certainly an object of dread to the passer-by. Ignorance, however, is the cause of his fear. Any automobile can be brought to a halt in two meters; a mechanical carriage of 700 kilos. possesses more rapid and powerful brakes than an omnibus with three horses, weighing 5,000 kilos.! In reality there is no mechanism more inoffensive, no means of transport more sure and safe.

This industry, which has received its birth in France and has here reached its present stage of development, is yet young. Still, even in this its youthful age, the automobile can even now render good service and give a pleasure unobtainable by any other means. If there are faults (and no one denies the fact), only time is wanted to make them disappear, and it needs no great prophet to predict that within a very few years a

stage not far from perfection will have been reached. Meanwhile we can only keep apace with the time by studying this new device and watching its progress, which, if we do, we shall be astonished at the rapid strides being made in our midst by science in this its most attractive manifestation, appealing to the present age more from an eminently practical standpoint than from any other. A. HENRY.

Paris, France.

WOODS' ELECTRIC MOTOR VEHICLES.

The art of motor vehicle construction has made such progress in the United States that one firm, the Fischer Equipment Company, of Chicago, are enabled to present twenty-nine different types of vehicles, including road wagons, runabout buggies, park buggies, park traps, brakes, stanhopes, phaetons, spiders, full mail phaetons, demi-mail phaetons, physicians' coupes, hansom cabs, victoria hansom cabs, landaus, station wagons, coach delivery wagons, hood delivery wagons, theater buses and depot buses. In fact, the company has about the same range of diversity in design that is offered by the large carriage manufacturers' catalogues of ordinary horse-drawn vehicles. The company are sole manufacturers of the "Woods' moto-vehicles," as they are pleased to term them. Elsewhere in this issue we give an illustration of a group of these vehicles as assembled before the Calumet Club, Chicago, preparatory to a run on the boulevards and avenues of that city.

The different types and characters are well set forth, and show that the art of the carriage builder has been admirably combined with the work of the electrician and the mechanician. The work of Mr. Woods on behalf of his company has been exclusively toward the production of fine artistic carriages and all the various styles and characters known to the carriage maker's trade, rather than the mere production of a self-propelling machine. The company is thoroughly well equipped for the manufacture of horseless carriages, and every part of them, with the exception of the rubber tires, is made in the factory. This insures a uniformity of workmanship and interchangeability of parts which is entirely advantageous to the purchasers.

WOODS' VICTORIA HANSOM CAB.

AN UP-TO-DATE VEHICLE MADE BY FISCHER EQUIPMENT COMPANY.

Our engravings represent the Woods' hansom cab and a two-seated trap. The hansom cab is a particularly fine specimen of the carriage builder's art. The driver sits back of the passenger and from his seat controls the motors and steers the vehicle. So simple is the mechanism that any driver of ordinary intelligence can learn to operate it in a very short time. The cab is equipped with two motors giving 6½ horse power, that is, sufficient battery capacity to run thirty miles with one charge of batteries. There are electric lights in the side lanterns and electric lights and electric foot warmers in the interior of the body. It is designed for use on any and all streets and runs at speeds which vary from 3 to 12 miles an hour. The total weight of these cabs is 2,600 pounds. Our other engraving shows an admirable two-seated trap to accommodate four persons.

The Fischer Equipment Company are making arrangements to build a large number of Woods' electric cabs for use in the city of Chicago, and in some of the large cities they have been received with so much favor that they are filling many orders for private use, and are building a number of vehicles for European trade.

The Woods' moto-vehicles are admirably designed, and one noticeable thing is that wood wheels and hard rubber tires are used almost exclusively. In practical tests of both wire wheels and pneumatic tires and wood wheels and solid rubber tires, it has been demonstrated to the satisfaction of the designer that the latter are far more desirable and endurable in many ways than the former, and present a more satisfactory appearance, and all annoyances due to punctures are done away with.

The control and operation of these vehicles has been reduced to much simplicity, so that it does not take long to acquire the skill necessary to operate them satisfactorily. One important feature is, that it is impossible to apply the brake to any of these vehicles without first cutting the power off from the motors. It is, also, impossible to apply the power without first liberating the brake. This is accomplished by an interlocking device between the brake and controller, the operation of both being effected by the manipulation of a single handle. A separate reversing switch is used which is provided with a lock, so that when the key is removed the vehicle cannot be operated by anyone not possessing a key. The various speeds are obtained by series paralleling the batteries, and in this work great pains have been taken to insure a uniformity of discharge from the batteries when in parallel; and contacts and connections of nearly four times the cross section ordinarily required are used, so that the resistance may be perfectly uniform.

In the light road buggy one motor is used with a differential gear, but in all the Woods' motor vehicles for hard and heavy work two motors are provided, one attached to either rear wheel, and every provision is made for automatic adjustment for the turning of corners or the turning of the vehicle completely around. The motors themselves are built with ironclad armatures and special coil windings, which coils are wound before being placed upon the armature. This enables the coils to be shipped anywhere, so that they can be fitted into the armature without any difficulty whatever by those who understand nothing about armature winding. The batteries may be charged while in the vehicle or duplicate sets may be substituted for them. The batteries are economical and the stated mileage capacity is conservative, and, under the proper conditions, the carriages will do 25 per cent more than their actual guaranteed figure.

The Consulting Cyclist.

The growing use of the bicycle and its frequent prescription as a means to health suggests, as a possibility, which, in fact, is already not far from its accomplishment, the evolution of a new kind of medical specialist, the consulting cyclist, who will devote himself to giving medical and practical advice as to all that concerns the use of the machine; whether to ride or not; what sort of a machine to ride; at what pace to ride; how the saddle is to be adjusted; where the handles are to be set; how the machine should be geared, etc.; all being things which differ for each individual. For, in truth, the fitting of the machine to the individual is a matter of no small nicety, and is one in regard to which the advice of a medical man knowing in such matters is of considerable importance. Many a doctor recommends the use of a 'cycle who is himself no cyclist, just as he may recommend hydropathic treatment, although he may know but little about the various combinations of bath treatment which will be found of greatest use at the particular spa resorted to. In stating the broad fact that cycling will do good, he is acting within the range of his own knowledge and experience; but when he is asked about speed and gears and lengths of run, unless he is a cyclist as well as a medical man, he is apt to find himself at sea, and so is tempted either to deal with these matters "on general principles" or to refer his patient to the dealer. But surely the decision as to all the details of bicycling, especially when bicycling is undertaken for health purposes, is a medical affair, and is also one which may very properly be made a specialty.—Hospital.

Bridges for Russia.

The Phœnix Bridge Company, of Phœnixville, Pa., has just received a contract for twelve steel bridges for the Russian government, and work will be commenced at once. The bridges are for the Eastern Chinese Railway, the southeastern extension of the Trans-Siberian Railroad. Work will be hastened as much as possible, in order that the material will reach its destination before winter begins. It will be shipped to St. Petersburg and thence by rail to Vladivostock. An engineer of the railway is now in Phœnixville, superintending the work.

Fall of Meteors in Indiana.

Two meteors fell at Vincennes, Indiana, on May 1. One struck a slab of stone on a Baltimore & Ohio freight car just as the train had crossed the Wabash bridge, and the slab was shattered by it. The other meteor struck a pile of brick with a loud noise and broke it into small fragments. It is doubtful if the fragments have been examined by scientific men as yet, but from newspaper accounts they appear to have been of a rocky rather than a metallic nature.

WYCLIFF'S English Bible, usually known as the Bramhall manuscript, from the Ashburnham collection, was sold at auction for $8,750, on May 1.

ELECTRIC MOTOR VEHICLES.

The wonderful development of electricity within the past few years, for power purposes, and its great economy, adaptability, and usefulness in that line, as shown by its universal adoption for the propulsion of street railway cars, also clearly demonstrate its superiority as a convenient and easily controlled power for motor vehicles, which are becoming so popular.

While the well known trolley car takes its power through the overhead or underground wires and conductors from an inexhaustible source of electricity, the motor vehicle is limited to the charge or amount it can carry, in consequence of the fact that it is intended to travel in places and over roads where there is no continuous outside supply of electricity. Hence, the means of storing electricity economically in the form of batteries is now one of the problems which is undergoing development.

New ideas are constantly being worked out, and it is confidently expected improvements will continue by which greater efficiency will result. At present, changes have been made in the construction of storage batteries whereby a surprisingly large quantity of active material is put into a small space, and this accounts for the neater appearance electric motor vehicles now possess over former designs. It is also a fact that the aggregate weight of battery for the amount of current discharge obtained is less than formerly.

The factor of weight is one of the features in electric vehicles that practical men are working to overcome, and it is said that whenever a storage battery or a system of storing the electric current is invented by which the weight of the battery is greatly reduced, there is certain to be an impetus given to the electric motor vehicle industry such as has never been thought of.

One of the essential requirements in a motor vehicle is that the reserve power shall be instantly available for a brief period of time, as, for example, when heavy grades are met with. In a storage battery this condition is perfectly met, the increase of current demanded being readily given off and accurately measured by the ampere meter, so that by observing the latter while traveling on an apparently level road one can detect slight grades by the varying position of the ampere needle.

The battery may be considered as an elastic equalizer capable of giving off in an instant the amount of current needed at various times and emergencies. This makes electricity an ideal power for vehicles, for it eliminates the complicated machinery of either gas, steam, or compressed air motors, with their attendant noise, heat, and vibration. It is not only serviceable as power, but also as light at night.

In the accompanying illustrations on the front page will be seen a new design for an electric surrey which has the appearance of an ordinary two seated carriage. The upper illustration, reproduced from a photograph, shows its appearance when on the road carrying a full load of passengers; the lower illustration gives an idea of the construction of the working parts. Referring to this, it will be seen that the storage battery is divided into two main parts, one section being in two boxes under the front seat and the other in two crates under the rear seat; access under the front seat is had by a door opening on the side, and the rear by the lowering of the hinged back of the carriage. The Willard storage cell is used, forty-four of them, the size of each is $3\frac{3}{4} \times 5\frac{5}{16} \times 9\frac{5}{8}$ inches high, and total weight nine hundred and fifty pounds. The active material is very compactly placed, yet arranged to provide a large surface. Insulated wires lead from the terminals of the battery to the controller located under the front seat just ahead of the battery, which controller is in the form of a cylinder having a number of contact plates on its surface separated by insulating material on which bear brass springs severally connected with battery in such a way that in one position of the cylinder only a few cells will operate, or in another so that they will be arranged in parallel, or in another in series, or in another for reversal of the direction of the current.

On the left hand end of the controller cylinder is a small cog wheel which meshes with a segment gear forming the lower end of the reciprocating controller lever standing in a vertical position between the cushions of the seat. The movement of this lever forward rotates the cylinder and puts on the current of varying degrees of quantity and intensity, according to the speed desired. There is a ratchet wheel adjoining the pinion of the cylinder on which a spring pawl acts as a temporary friction lock, holding the cylinder in whatever position it is placed, yet yielding to the motion of lever when forced forward or backward by the hand.

Pushing the lever forward one notch or click of the spring below gives a very slow speed of two to three miles an hour, to the second notch six to seven miles an hour, to the third notch ten to twelve miles an hour, to the fourth notch fifteen miles an hour. By drawing the lever back to the vertical position the current is thrown off. Running the length of the lever is a latch rod terminating at the upper end of the handle. To reverse the current for backing, this rod is pressed downward with the thumb at the top of the handle, which permits the controller to rotate in the opposite direction. Two different speeds for backing may be used. Thus one lever is used for a forward or backward movement. The driver sits on the left hand side of the seat, operating the driving lever with the right hand and the steering lever with the left. The steering shaft rises vertically through the bottom of the carriage, just in front of the driving lever, and is hinged so that the upper part can lie in a horizontal position, either to the right or the left. The driver, in the upper illustration, is in the act of operating the steering lever. An electric push button is inserted in the handle connected with a signal electric bell, seen attached to the underside of the bottom of the carriage, at the front. The signal is sounded by pressing the button with the thumb of the left hand. Under the left hand end of the front seat is a special safety switch for completely cutting off the current. At the opposite end is another switch for the electric dash lamps observed on each side. Beside this switch is a three-knife switch which is turned down for charging.

AN ELECTRIC VICTORIA.

The vertical steering shaft is connected underneath the carriage by a crank and rod with one end of an interior movable hollow hub, around which the front wheel runs on ball bearings; the hub is pivoted on its interior to the carriage frame. Another connecting cross rod extends from this hub to the same style of hub on the opposite side. So that the movement of one hub by the steering shaft operates the other in the same direction, both moving parallel to each other. This enables the steering to be done very easily.

THE RIKER ELECTRIC DELIVERY WAGON.

The carriage frame which supports the springs is built of strong steel tubing, well braced and jointed. The foot brake lever projects slightly above the floor, and has side notches for holding the lever in any position it may be placed. From this lever under the carriage, the brake rod extends to a band brake wheel secured on the rear tubular propelling shaft adjoining the large gear wheel, also keyed on the same shaft. To exclude dust, these are covered by a metal casing which is removed in the illustration for more clearly showing the driving mechanism.

An additional safety hand brake is provided, the lever of which will be seen just inside the front seat frame, and operates the usual brake-shoes which bear against the rear wheels.

The motor, of 2 kw. capacity, is inclosed in a tight metal case; one side is clamped firmly to the axle casing, the other side is loosely secured on a vertical rod, but clamped between two spiral springs inclosing the rod. The object of the spring is to compensate for the sudden thrust or strain put upon the motor when the current is quickly applied, either for going forward or backward. The pinion of the motor is made of rawhide edged with metal, and meshes into the large gear driving wheel previously mentioned. This construction makes a noiseless gear.

The rear axle is constructed in two parts. One is a solid axle attached rigidly to one rear wheel, while the other end is connected by a differential gear in hub of the other wheel with the tubular driving axle, both being incased in a stationary tubular axle and run on roller bearings. The solid and tubular axles both revolve together ordinarily, except when turning curves; then, by means of this gear, one may rotate slower or faster than the other. Such construction permits the vehicle readily to turn small circles and curves.

A later form of applying the motive power is to employ two 2 kw. electric motors, each attached to a solid rear axle and adjacent to each rear wheel. On the interior face of the wheel is a concentric toothed rack in which the motor pinion engages, thus applying the power directly to the wheel instead of to the axle. This construction will be observed in the illustration of an electric delivery wagon, and it will be noted that the wheels are of wood, fitted with solid rubber tires. The battery in this vehicle occupies the floor space in the bottom and rises nearly level with the driver's seat. In other respects the controller and brake mechanism is the same. The weight of this vehicle is 3,600 pounds. It is extremely convenient to operate in crowded streets, and is more economical to run than a horse vehicle. With one charge of the battery the vehicle is capable of running 30 miles on a smooth, hard pavement.

In another illustration will be seen a single-seated victoria rich and handsome in appearance. In the piano-like extension on the rear is the battery. The vehicle has pneumatic rubber tires and is operated on the same plan as the others. It weighs 1,800 pounds and has run a total of nearly 5,000 miles.

Electric vehicles are provided with a special socket under the floor, in which a brass plug fits for charging and making connection readily with the source of electricity.

The charging of the storage battery occupies on the average about two hours' time, the quantity of current being varied to suit the rise of the voltage.

It should be mentioned that the weight of the electric surrey is 2,700 pounds and that it travels a distance of 25 miles on a level road on one charge. It has a combination ammeter and voltmeter on the dashboard in front of the driver, and thick pneumatic rubber tires blown to a pressure of 125 lbs. to the square inch. The wheels are about three feet in diameter. Adjoining the light switch on the left is a three-knife switch, which is turned down when the carriage is charged.

All of the foregoing described motor vehicles were designed and manufactured by the Riker Electric Motor Company, Nos. 45 and 47 York Street, Brooklyn, N. Y., on what is known as the "Riker system," after the patents of Mr. A. L. Riker, a well known mechanical and electrical engineer. The company has recently introduced another type, the "brougham," a very serviceable vehicle, and have supplied customers in France and England with their vehicles. Several of these vehicles are to be seen at the Electrical Show at Madison Square Garden.

Relief Expedition for Lieut. Peary.

The sealing steamer "Hope" is to be thoroughly overhauled and repaired preparatory to proceeding northward next month with an expedition for the relief of Lieut. Peary, who went to the Arctic regions last summer with a specially selected party. It is thought that he may now need assistance, as his steamer, the "Windward," has been frozen in the ice floes since the early part of last winter.

More Locomotives for England.

According to recent cable advices, it is stated that the Midland Railway of England has arranged to place another contract for 130 locomotives with American firms. It is understood that the Great Northern Railway will also order a large number of engines of the mogul type from American locomotive builders.

THIEVES have taken nearly all the brass work of the Yerkes electric fountain in Lincoln Park, Chicago, and, of course, in taking the brass fittings, they did great damage to other parts of the fountain.

SOME EARLY FORMS OF THE AUTOMOBILE.

The great interest and activity which have been shown during the present decade in the question of automobilism, and the fact that early in the previous decade such a thing as a practical automobile did not exist, would lead one to suppose that this was an entirely modern method of locomotion—an attempt, in fact, to extend the autotractive principles of the locomotive to our city streets and country highways. As a matter of fact, however, the automobile antedates the locomotive. The rude steam carriage of Cugnot was built over half a century before the locomotive, and a practical steam coach was carrying people on the roads several years before the railway was an assured success. Indeed, some excellently designed and successful steam coaches were in operation and running on a regular schedule during the early years of the steam railway, and had it not been for the sudden diversion of public interest and capital from road traction to rail traction, we would not at this late day be working on the problem of the best forms of body, frames, and motor for locomotion on the roads.

Unquestionably, the credit of having designed and constructed the first mechanical road carriage belongs to a Frenchman, Nicolas Joseph Cugnot, who built and ran in 1763 a successful model, and subsequently, in 1769, constructed for the French government a three-wheeled steam gun-carriage for transporting heavy ordnance. The well known illustrations of this carriage show it to have been a very crude affair. It was carried upon three wheels; the gun resting between the larger wheels, and the boiler and engines being placed so as to overhang the trolley. This single wheel was both driving and steering wheel in one, and it turned about a king-pin, the vertical engines being so mounted as to permit this rotation. The boiler was a kettle-shaped affair, with a fire-box formed in its base, and a steam pipe which led from the dome-shaped top to a two-way valve, communicating with a pair of vertical bronze cylinders. The rotary motion was secured by means of pawls on the piston rods and ratchet wheels fixed to the driving wheel. Crude as Cugnot's machine was, he deserves every credit as the pioneer builder of an automobile carriage.

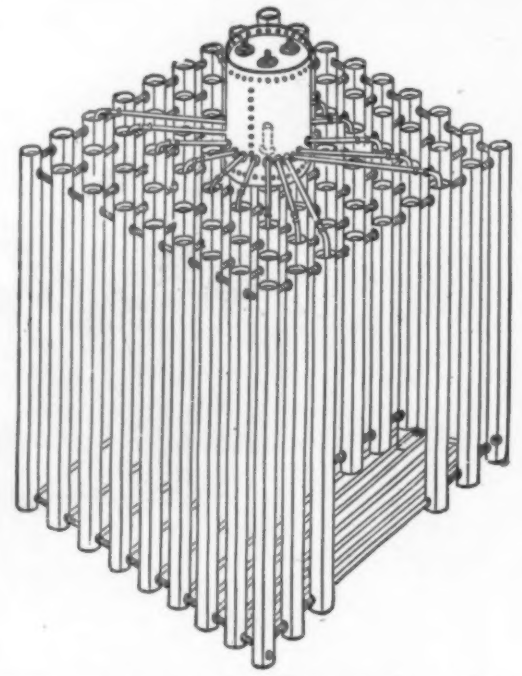
For the next practical carriage we must cross to England, where Murdoch, in 1781, built and ran a model steam tricycle which is now preserved in the Birmingham Museum. William Symington, whose name is closely associated with the early development of the steamship, turned his attention to steam road carriages, and in 1786 built a road coach in which the movements of two pistons were communicated to the driving wheels by racks and pinions.

In America the name of Oliver Evans is honorably associated with the history of the steam carriage. In 1786 he applied to the Legislatures of Pennsylvania and Maryland for a patent on steam wagons, and began the construction of one, although later he neglected it for other pressing and more profitable enterprises. About this time, however, he moved an engine from the factory, where it was made, to its final position by placing it on wheels and gearing the wheels to the crankshaft. Nathan Read, in 1790, applied for a patent on a steam carriage and constructed a model. He proposed to use two double acting steam engines, and his design is specially meritorious because he made use of his multitubular boiler—an indispensable element to the complete success of steam-driven carriages.

In tracing the growth of the automobile we must again cross to England and take note of the work of Trevithick, the man who, perhaps, more than all others, is entitled to be called the Father of the Locomotive. During the closing years of the eighteenth century he built several models, and in 1801 he built a full sized road coach which had its trial on Christmas eve of that year. A quaint account of the trip by an eye witness and participant will bear repetition: "In the year 1801, upon Christmas Eve, towards evening, Captain Dick (Trevithick) got up steam. . . . When we see'd that Captain Dick was a-going to turn on steam, we jumped up, as many as could—maybe seven or eight of us. 'Twas a stiffish hill going from the Weith up to Comborne beacon, but she went up like a little bird. . . . As we were very squeezed together, I jumped off. She was going faster than I could walk, and went on up the hill a quarter of a mile further." Pretty good work for a trial trip, up hill, with an overload of passengers, and in the year 1801!

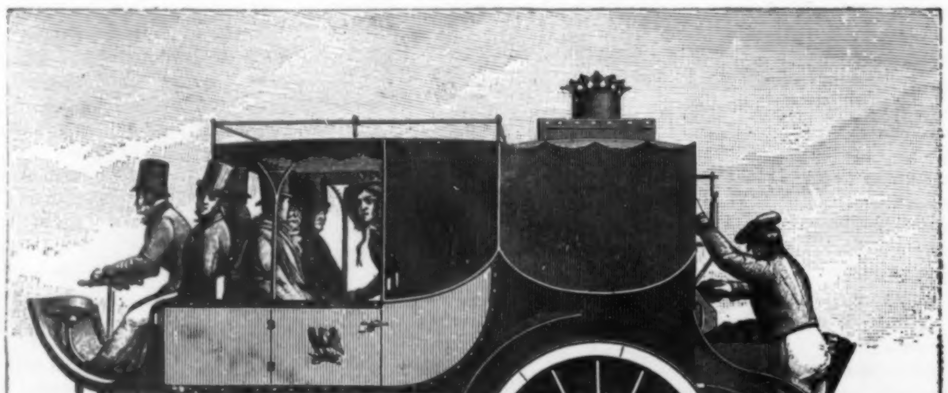
Trevithick, like many a pioneer inventor before and since, grew disgusted with the opposition or apathy of the public and turned his genius in other directions. He was succeeded by less talented and practical men, who, fearful that they could not secure sufficient adhesion, built rack railways, or attempted, like Brunton in 1813, to imitate the action of a horse's legs, and actually built machines that were prodded along by jointed iron legs that pushed against the ground.

The first attempt to place on the roads a mechanically propelled stage coach was made by W. James, assisted by Sir James Anderson. The illustrations show this very ambitious vehicle, which was capable of carrying twenty people, to have been modeled on the lines of the horse drawn stage coach. It was driven by a pair of two-cylinder engines, and it proved its carrying ability when, on the failure of one of the engines, it made the homeward trip from Epping Forest to London at seven miles an hour with a full load of passengers.



MACERONE AND SQUIRE'S WATER-TUBE BOILER. PRESSURE 150 POUNDS.

In 1822 Sir Goldsworthy Gurney, a man of high scientific attainments, took up the steam-carriage problem and placed several steam coaches on the high-roads. He succeeded in climbing the steepest hills in and around London, and only gave up his attempts when the opposition of vested interests rendered them unprofitable. At the same period Hancock was achieving remarkable success in the construction of large steam omnibuses, of which he built nine in all.



THE MACERONE AND SQUIRE STEAM CARRIAGE, 1833.
Cylinders, 7½ inches by 15¾ inches; water-tube boiler, forced draught, and 150 pounds steam pressure; average speed, 14 miles an hour.

Upon the retirement of Gurney, one of his employes, J. Squire by name, constructed a steam carriage. Assisted by Col. Macerone, he subsequently built several practical carriages, one of which is shown in the accompanying illustration. It will be seen that it was a four-wheeled affair, with the passenger accommodation in front and the boiler behind. The latter was of the vertical, water-tube type (see cut) with a central steam receiver, and carried a working pressure of 150 pounds! Think of that! A pressure which engineers in most other lines of mechanical development did not venture to use until half a century later. The engines were mounted between the frames and connected to cranks on the rear axle. The cylinders were 7½ inches diameter by 15¾ inches stroke. The furnace, which was practically self-fed, was fed from a hopper, and forced draught was secured by means of a fan, driven by belting from a pulley on one of the rear wheels. This coach ran 1,700 miles without repairs. It used coke for fuel, at a cost of about seven cents per mile, and its average speed was 14 miles an hour.

It is beyond the scope of this article to pursue the subject further or speak of the labors of such men as Benstall and Hill, Anderson and James, Heaton, Church, and the great Scott-Russell, builder of the "Great Eastern," and others less known; but enough has been said to prove that the present activity in automobilism is merely a revival of an industry which, over sixty years ago, had advanced to a high stage of perfection, and but for the success of the railroad and the bitter opposition of the stage coach and other vested interests, would undoubtedly have kept pace in its own sphere of usefulness with the steam railroad. The attempt to establish the steam carriage on a permanent footing failed, and, except for occasional and widely separated attempts to improve on the early forms, nothing was done for a period of half a century. The next serious attempt to develop the automobile was to take place in the country of the pioneer builder of these machines, for to France belongs the credit for the modern revival of the mechanical road carriage. A condensed history of automobilism in Paris (which is France) will be found in another column.

A Novel Path for Bicyclists.

The lot of the wheelman is not a particularly happy one in the mountainous region about Los Angeles and Pasadena, in Southern California, for cycle paths are unknown, and beyond the city limits the country is so rolling that the pleasures of cycling are not commensurate with the pains. All this is to be changed, however, by the construction of an elaborate wheelway which is probably unique.

An elevated cycle path is to be erected between the two places, which will be nine miles long. It will be remembered that Pasadena and Los Angeles are sister cities, and the problem of transportation between them has been slow of solution, owing to the fact that the country between the two places is of such a rolling character, and also on account of the numerous waterways, or "arroyos secos," as they are called. The cities are now connected by three railroads and one electric road. There was, however, no foot road for cyclists. The common wagon roads, with their dust and mud and ruts, had to be followed, which made cycling anything but pleasant. In spite of these drawbacks, there was a certain amount of bicycle riding between the two cities, and in the face of discouraging circumstances, it was found that there were at least 30,000 wheelmen in Los Angeles County alone. In view of these facts, Mr. Horace M. Dobbins, of Pasadena, organized what is known as the "California Cycleway Company." The capital was quickly forthcoming, and plans were drawn for an elevated speedway between the sister cities, which is to be exclusively devoted to cyclists. The franchise and rights of way have now been obtained and the work has actually begun.

The path is supported by pillars of varying heights to take up the inequalities in grade. The floor is of boards and is 10 feet wide. There is a 4-foot lattice work fence on each side, to protect the cyclists. The pathway will be lighted by electric lights, staggered across at intervals, as on the Brooklyn Bridge. Midway between the two cities a park and casino will be built by the company. The charge for the use of the structure will be merely nominal, and annual passes will be issued with each share of stock. Special attention has been paid to the grades, and the trip northward to Pasadena from Los Angeles will be no hardship, as the grade is almost imperceptible. Cyclists will now be permitted to view the beautiful scenery without having to look out for ruts in the road.

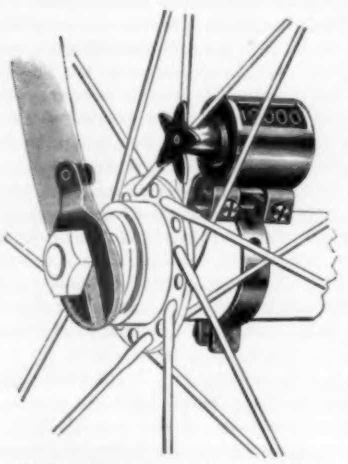
M. MUZIN, who obtained much valuable information about the Congo region by his journey to the center of Africa, made from 1889 to 1892, died at Zanzibar.

NEW METHOD OF MOUNTING CYCLOMETERS.

One of the causes which has led to many riders discarding their cyclometers, much against their inclination, is the fact that they are easily broken off when the wheel is put into a rack or stacked up with others, or become bent so that the trip does not engage and the record is lost.

Having in mind these objectionable features of the cyclometer in general, the New Departure Bell Company have introduced the cyclometer shown in the accompanying illustration.

The cyclometer proper is mounted inside of the spokes and upon the hub, the star wheel projecting just through the spokes, but not far enough to catch or hit anything. The trip is mounted on the axle inside of and behind the fork, thus being entirely out of the way. In the illustration the bicycle fork is made transparent, so that the trip may be seen.



NEW METHOD OF MOUNTING CYCLOMETERS.

It will be noted that this construction at once removes all source of danger to the cyclometer and affords the rider the means of keeping his mileage correctly without danger from breaking or mischievous handling.

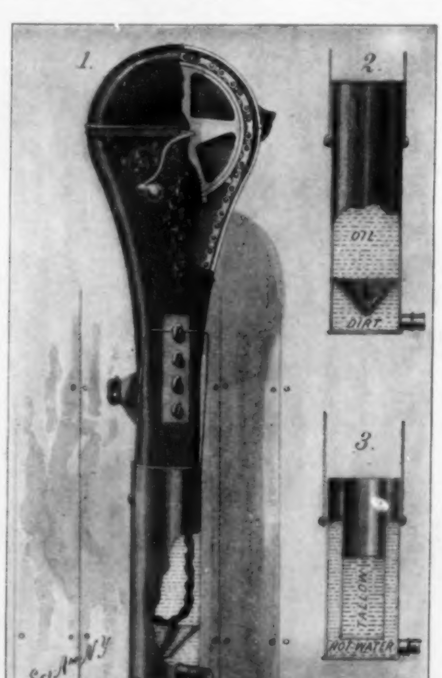
Every gear of this cyclometer is machine-made and finished accurately to gage. No soft metals or cast parts are used. None but the best hard brass and special nickel silver enters into its manufacture.

A MECHANICAL BICYCLE-CHAIN CLEANER.

The ordinary method of cleaning a bicycle chain by means of kerosene has its disadvantages, chief among which may be mentioned the lack of any means for "filling" the chain after having been cleaned, so that no dirt shall enter the joints. A mechanical chain cleaner, made by the American Bicycle-Chain Cleaner Company, 106–108 Beekman Street, New York city, provides a means whereby the links can be properly "filled" and lubricated after having been cleaned.

The chain cleaner in question comprises a receptacle having a hinged cover, two cups which can be attached to the receptacle, and a sprocket wheel mounted in the upper part of the receptacle and operated by a crank.

Of the two cups, one is designed to contain kerosene and the other tallow. The kerosene cup is provided with a false bottom having a hole through which the dirt gravitating from the chain may pass. The tallow cup is provided with an outer and an inner compartment. Within the inner compartment tallow is placed, which is melted by hot water poured into the outer compartment.



A MECHANICAL BICYCLE CHAIN CLEANER.

The chain, after having been removed from the bicycle, is hung upon the sprocket wheel in the upper part of the receptacle. The kerosene cup is then hung in place, so that the lower portion of the chain is immersed in the oil. By rotating the sprocket wheel rapidly, the dirt will be removed from the chain and will gravitate through the false bottom of the cup. When the chain has been cleaned, the kerosene cup is removed, and the tallow cup substituted therefor. The sprocket is then turned again to "fill" and lubricate the chain. After having been removed from the hot tallow the chain is hung up to cool.

Thus "filled," the chain is protected against the admission of dirt by a coat of tallow which remains in the joints for a considerable time.

The manufacturers have subjected their device to severe tests. Seventeen links of a chain became eighteen inches long after three thousand miles had been ridden without cleaning, graphite and oil being used to lubricate the links; while seventeen links became only seventeen and three-sixteenths inches long after a ride of fifteen hundred miles, when the chain cleaner had been used.

Bicycles for Firemen.

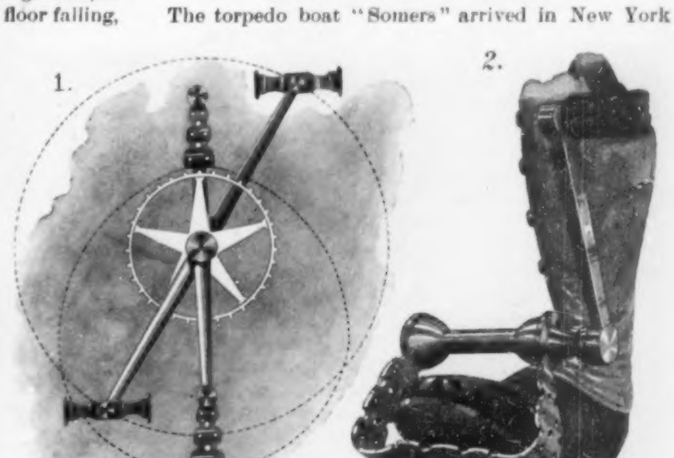
Radical changes are being made in the fire system of Washington, D. C. The most important is, without doubt, the mounting of firemen on bicycles. Commissioner Wight, noting the success which has attended the formation of police bicycle squads, decided to also mount a certain number of firemen on bicycles. At each engine house a fireman was selected to ride a bicycle. Whenever his company is called out he precedes it to the fire. A man mounted on a bicycle can make much better time over the perfect asphalt streets of Washington than a heavy fire engine drawn by horses. Every second is important in a fire, and in many cases, when lamps are overturned or draperies catch fire, the presence of an experienced man with the necessary appliances might prevent disastrous fires by attacking the blaze in its incipient stage. It is estimated that firemen on bicycles are able to reach the fire on an average of three minutes before the apparatus, and where four or five companies respond to a fire an equal number of trained men would be at the point of danger at about the same time, and might often accomplish a great deal before the engine and ladder companies arrive. Each bicycle fireman will carry a small chemical fire extinguisher upon his back, and he may also carry a light pick.

Among the other innovations which have been introduced is the use of a megaphone for giving orders, taking the place of the old firemen's trumpet. Since these novel features have been introduced the Commissioner has received many sensible suggestions, one of them being for a chemical fire extinguisher of considerable size to be carried on a duplex bicycle propelled by two men. Such an arrangement could also carry a scaling ladder and picks. An automobile chemical fire extinguisher and ladder cart would be particularly desirable in either city or country, especially in the latter, where horses are not readily obtainable at the moment of a fire. No town is so poor that it could not afford at least one piece of automobile fire apparatus. It would be ready at a moment's notice to go immediately to the scene of danger, would cost nothing for maintenance, and, with proper inspection, there would be no danger of its giving out at a critical time. Other suggestions for improvements in fire fighting is a small telephone outfit to be carried on the backs of firemen. As the fireman dashes into the building the wire could be unwound automatically from the reel, and he could readily communicate with the chief on the ground, so that if there were any danger of a wall or floor falling, the firemen could be notified. Of course, it might be said that the wires would be injured by the fire itself, but there are many occasions on which firemen do most of their work from adjacent buildings, where there would be no danger of the wire being destroyed or even of the insulation being burnt off.

A NOVEL STIRRUP-PEDAL FOR BICYCLES.

A stirrup for bicycles has been patented by Carl F. Kabisch and Raphael B. Garcia, 95 Broad Street, New York city, which is designed to enable a rider to exert greater power on the downstroke than would be possible if the ordinary form of pedal were employed, and to obtain a better control of the wheel when back-pedaling.

The stirrup is pivoted on the pedal-pin of the crank by means of a sleeve swinging on ball-bearings. Whatever may be the position of the crank, the stirrup will always hang vertically.



A NOVEL STIRRUP-PEDAL FOR BICYCLES.

The foot on the downstroke exerts force upon the bottom of the stirrup, and on the upstroke the foot will bear against the pedal-sleeve. Power is therefore applied on both up and down strokes. It is claimed for the stirrup that it dispenses with the necessity of toe-clips; that high knee-action is overcome; and that in back-pedaling the rider is enabled to stop his wheel more quickly than would otherwise be possible. From Fig. 1 it is evident that the crank can be made shorter than usual, because the stirrup-pedal being always in vertical position, the length of the upstroke is that of the crank and the length of the downstroke that of the crank plus the depth of the stirrup. It follows, therefore, that the path of the foot is elliptical, thus enabling the rider, as before mentioned, to apply more power than would otherwise be possible.

A SIMPLE BICYCLE-SUPPORT.

The subject of the accompanying illustration is a bicycle support, so constructed that, when not in use, it may be folded closely against the bicycle-frame.

Fig. 1 is a view of a bicycle with the support attached. Fig. 2 represents the lower brace of a bicycle with the support in closed position.

The support comprises a tube in which a rod telescopes. The tube has a longitudinal slot with offset slots at the ends in which a pin on the rod is capable of engaging. When the pin is in the lower offset slot, the parts are held rigidly in supporting position. When the support is folded against the frame, the pin is turned into the upper offset slot to prevent an accidental outward movement of the rod.

WARD'S BICYCLE-SUPPORT.

The support is pivoted to the bicycle by means of a yoke on the tube, which yoke embraces the bicycle-frame and enables the support to be swung out of operative position.

To the forward part of the lower brace a second yoke is pivoted, which serves the purpose of preventing the turning of the front wheel. This yoke is so connected by means of a wire with the support-tube that, when the support is swung into operative position, the yoke will be made to embrace the front wheel, and, when the support is folded up against the lower brace, the yoke will be swung out of engagement with the front wheel.

In order to hold the support against the frame, spring-clips attached to the lower brace are employed.

The inventor of the device is Frank J. Ward, of Fitchburg, Mass.

Arrival of the "Somers."

The torpedo boat "Somers" arrived in New York on May 2, on the Atlantic Transport Line steamship "Manhattan." We have already referred to a large number of accidents which have occurred to the "Somers." She will be taken to the Brooklyn navy yard, where an attempt will be made to put her in an effective condition. The "Somers" has a single screw and is 156 feet long; her beam is 17 feet 6 inches and she draws 4 feet 6 inches of water; she registers 145 tons and has two smokestacks, a conning-tower, and one torpedo tube; she mounts no guns.

THE DARING FEATS OF A TRICK-RIDER.

The habitués of the Variété Battenberg, in Leipsic, recently had an opportunity of witnessing the astonishing feats of an American trick-rider, N. C. Kaufman, whose performances probably surpass anything which has yet been attempted in Europe.

Our German contemporary, Die Illustrirte Zeitung, remarks that Kaufman's tricks are so startling and often so daring that a description of them would fill a goodly sized volume. When Kaufman first appears upon the stage, he lays his wheel upon the floor. He then runs up to it, and in a flash, placing both feet upon the pedals, swings himself into the saddle. Then a series of remarkable tricks rapidly succeed one another. He stands upon the step and drives the bicycle with his hands. He seats himself in the frame and, guiding the wheel with one hand and turning the pedal-crank with the other, rides at full speed about the stage. Then, unwinding himself from his uncomfortable position, he swings himself into the saddle again, and, raising the front wheel at the same time, turning the handle bars completely around, pedals about supported only by the rear wheel.

While riding in this way he performs all conceivable acrobatic feats. One of our illustrations, for example, shows him standing upon his head—a feat which requires the utmost firmness and coolness. He confines himself not to the safety alone, but also performs his tricks on the old-fashioned "ordinary," exhibiting many new feats in addition to the conventional tricks of most trick-riders. In spite of the many break-neck experiments which he has made, he has never been seriously injured, although accidents have occurred. Kaufman was born in Rochester, and first came into notice at a race given by the Rochester Bicycle Club. At the present time he is probably the best-known of all trick-riders.

THE HISTORY OF THE BICYCLE.

The history of the bicycle has been written so many times that it is undoubtedly an old story to many of our readers, still, for the sake of those who may not be familiar with it, we give the following brief outline. The now historic types in the evolution of the modern bicycle are so well known that we have refrained from reproducing illustrations of them.

The germ of the modern bicycle is found in the "hobby-horse" which was popular at the beginning of the present century. In brief, it consisted of two wheels connected by a rigid frame of wood; the rider sat on a saddle midway between the wheels and propelled it by means of strides on the ground. No provision for steering was made, so that its motion was limited to a straight line. In 1818 Baron Von Drais arranged this cumbersome machine so that the front wheel could be steered. That such a clumsy means of locomotion should soon fall into disuse was not at all strange. We have now had two wheels arranged in tandem, then the steering head was invented which permitted one of the wheels to turn, and finally the third step consisted in contriving a mechanism by which the affair could be propelled without touching the feet to the ground. Such a machine is credited to two Scotchmen, Gavan Dalzell and a man of the name of MacMillan. It was usually supposed that Dalzell's invention dated from 1834, but in 1892 a close examination of the matter resulted in the downfall of the legend, and even the original blacksmith's bill was found, which proved that it was made in 1847. In Dalzell's device there were no true pedals in the ordinary sense of the word, the feet describing only a small segment of a circle. The motion was transmitted to a crank attached to the axle of the rear wheel by a lever.

It was to Ernest Michaux, a young Frenchman, that we are indebted for the fourth great step in the development of the bicycle. In 1855, while repairing one of the old machines invented by Baron Von Drais, he conceived the idea of applying cranks directly to the front wheel. The Michaux bicycle, or "velocipede," as it was called, soon attained great popularity, and the early types of this machine, or "bone shaker," have undoubtedly been ridden by some of our readers. Bicycle academies were established and races were run, and the machines even penetrated the far East. In 1869 a Parisian, M. Magee, still further improved the velocipede by making it entirely of iron and steel. And in the same year rubber tires were introduced. In 1869 M. Michaux conceived the idea of making the front or drive wheel larger than the rear wheel, and brakes were also introduced. The result of the constant improvement was the old so-called "ordinary" or "spider" wheel, which remained very popular for the next fifteen years. The new wheel weighed from 35 to 50 pounds, instead of 80 to 100 pounds of the old velocipede. There were many dangers connected with the high wheel, however, and various expedients were adopted to avoid the danger of falls, such as placing the small wheel in front and propelling the machine by levers, straps, and ratchets. In 1880 Starley introduced what was called the "Rover," which was the true prototype of the modern safety. The wheels were both low, the larger one being in front. The rear wheel was driven by chains and sprockets, the same as in the wheel of to-day. Little by little, changes occurred in the frame and great improvements were made in construction. Complex shapes which were once thought impossible to produce are now forged and brazed together. The strength of materials used in bicycles has been studied with great care, and the result has been that it is entirely possible to make a thoroughly satisfactory wheel which will weigh 22 pounds. At first manufacturers built the frames on dissimilar lines. Every manufacturer had a model of his own. Soon the frames of the wheels began to have a general resemblance, and at last the almost straight line pentagonal diamond was adopted. Gradually the top bar of this frame was raised, until to-day it is parallel with the ground. In its frame the bicycle is a veritable mechanical and engineering achievement. The bearings received more and more attention, until now a wheel will travel thousands of miles without showing any appreciable wear to them. In the old velocipedes the frame was rigid; then springs were introduced, the cushion tire followed, and finally the pneumatic tire was resurrected from the old patent records, thus furnishing the ideal spring between the rider and the ground, minimizing the jar due to inequalities of the road and giving a maximum of ease and comfort to the rider. By such steps was the simple diamond frame wheel evolved from a construction which was almost a mechanical impossibility. The mechanical difficulties connected with the tricycle are less than those connected with the bicycle, but tricycles have never been particularly popular, even when built on the lines of the modern bicycle. Perhaps the greatest field for the tricycle is where it is propelled by a motor, and in the present issue we illustrate the leading French motor tricycle.

There have been a number of special forms of bicycles on the market, of which the chainless wheel is perhaps the most interesting and important. The chainless bicycle does away with the dust and friction of the chain, the shaft being substituted. Many riders claim that the chainless wheel runs steadier than the chain-driven wheel. Various devices, some of them highly successful, have been used instead of bevel gears. Most manufacturers of chainless bicycles still continue the manufacture of chain-driven wheels. The tandem is also one of the best examples of the special form of bicycle, and, strange to say, it goes back to 1869, when the device was invented which made it possible for two people to ride on a velocipede, the back saddle being intended to be used either as a side saddle for a woman or as a man's saddle. The advantages connected with a tandem are many. Geared up to high speed, a tandem runs with great ease, and the two riders are able to carry on conversation. The absence of vibration and the power which the tandem has against a head wind have all conduced to make it popular. Gradually came the demand for higher and higher speed for pacing and racing purposes; so we now have six or even seven riders mounted on a single pair of wheels. The sextuplet wheel really represents a remarkable engineering achievement, as the truss which is formed may have to support a thousand pounds. Such a wheel is

THE DARING FEATS OF A TRICK-RIDER.

geared to 153, so that every revolution of the pedals carries the wheel 38¼ feet.

Ladies' wheels early attracted attention after the safety was in use, and to-day lady riders are numbered by hundreds of thousands. The lady's wheel presented a more difficult problem than the ordinary bicycle, as the diamond frame was necessarily abandoned, but a lady's wheel is now produced which is equal to a man's wheel, with a slight increase of weight. The first drop frame, or lady's machine, was patented in the United States in 1887.

THE ART OF TRICK RIDING.

There are few regular attendants at bicycle races and bicycle tournaments who have not witnessed the remarkable performances of some trick bicycle riders, and trick riding has also proved very popular on the vaudeville stage. No one but an experienced cyclist can fully appreciate how expert a rider must be in order to perform even the simplest bicycle riding act. It gives us great pleasure to present some illustrations of remarkable feats performed by Lee Richardson, the representative fancy bicyclist of this country. Lee Richardson is the son of Mr. L. M. Richardson, of the Monarch Cycle Manufacturing Company. Lee Richardson was born in Milwaukee, Wis., and attained his wonderful proficiency by most careful study and practice. He considers that one of the important points in trick riding is to ascertain the limit to which one can safely go in the manipulation of his machine in the execution of fancy evolutions. It is, of course, essential for the rider to know every peculiarity of his wheel, and the possibilities and contingencies which have to be guarded against. Unlimited patience and exhausting practice are necessary to become a trick rider. Grace and ease are required by all trick riders, but this all comes in time. Considered from a scientific standpoint, fancy bicycle riding brings every muscle in the body into play, and even practice in the simpler maneuvers will, in a short time, give increased strength and skill, and in a very little time muscles will begin to develop of whose existence the rider was practically ignorant.

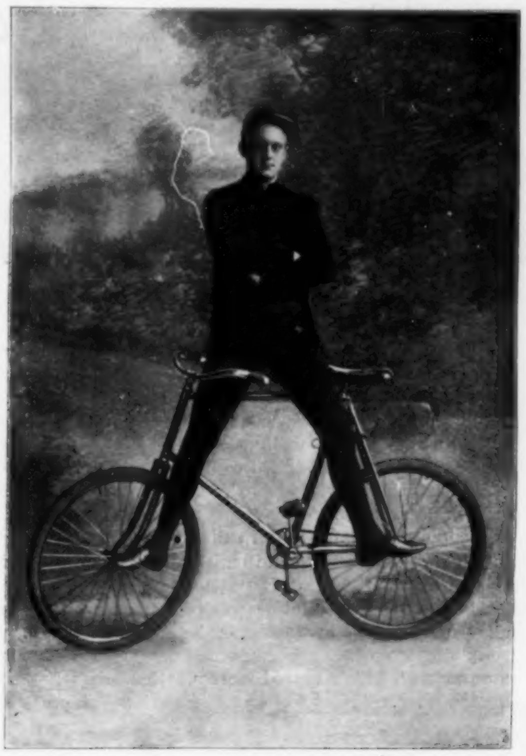
Riding on Dismembered Bicycle.

The bicycles of trick and fancy riders are specially constructed, for they require to be built additionally strong, as the regular light wheel will not stand the great strain to which the trick wheel is subjected. Such wheels vary in weight from twenty-eight to thirty pounds. The wheels are usually of a diameter of twenty-six instead of twenty-eight inches, and the frame is well reinforced. The front fork is arranged so as to permit of the front wheel making a complete revolution without coming into contact with the lower tube of the diamond frame.

The wheel ridden by Mr. Richardson is fitted with changeable gear, which permits of his going from the saddle through the frame and remount the saddle again while the machine is in motion—a trick which cannot be performed without the device mentioned.

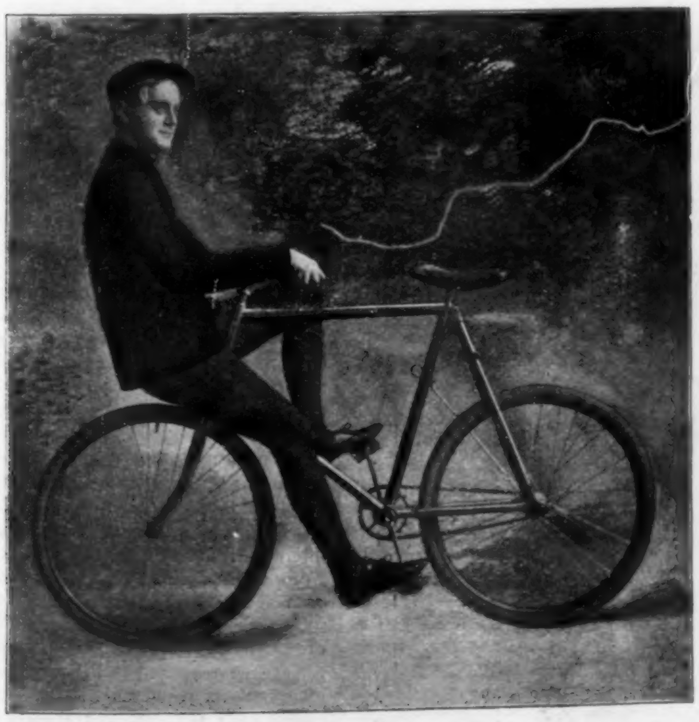
The simplest trick riding is to learn to ride on the machine without keeping the hands on the handle-bar. This is practiced by thousands of riders who never think of performing any tricks. Then follow side-saddle movements and various kinds of standstills. After the rider has become proficient in these comparatively simple tricks, it is possible to make trials of harder ones. One of the most difficult of fancy riding tricks was originated by Mr. Richardson; this is the riding of the machine backward while seated in the saddle in the regular way. This trick requires weeks of hard work before any success can be obtained. Mr. Richardson is to have an eight weeks' season in London.

Riding on the Rear Wheel.



Maintaining Equilibrium Under Difficulties.

Riding Without a Handle Bar.



A Difficult Feat.

Driving the Wheel by Hand.

THE ART OF TRICK RIDING.

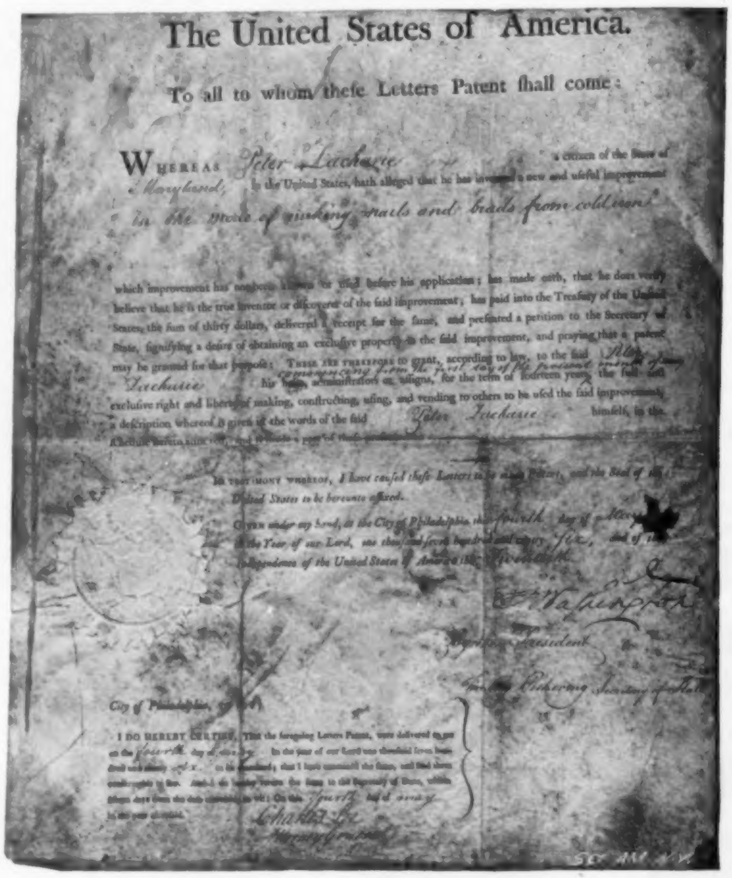
EARLY FORMS OF LETTERS PATENT.

The forms which letters patent for inventions have taken at different stages in the history of this country are various and interesting. In colonial times their form was that of a grant directly from the legislative bodies. There were no general patent laws, but a separate act was passed for each patent, and each act was conditioned to fit the merits of the particular invention which it was to protect. These acts usually recited that, whereas the petitioner had made a certain invention which was esteemed to be valuable; it was, therefore, enacted that he should have certain exclusive rights in the invention for a specified time and under certain conditions.

The earliest patents contained no description of the invention except its title, and the identity of the invention had to be established by extraneous evidence. Some of the later colonial patents contained quite complete statements of the object and mode of operation of the invention, but there was no detailed description of the invention. The first patent to contain a specification was granted in 1712 to John Nasmyth.

The term of the grant varied according to the importance of the invention, but was usually fourteen years, in conformity to the British system. Conditions were frequently attached to the grant. For instance, the General Court, or legislature, of the Massachusetts Bay Colony in 1646 granted a patent to Joseph Jenkes for "manufactures of engines of mills to go by water for speedy dispatch of much work with few hands," enacted that "no other person should set up or use any such new invention or trade for fourteen years," and imposed the conditions that the court should have power "to restrain the exportation of such manufactures and the prices of them to moderation if so required."

Patents granted under all the various patent laws of the United States have had the caption "The United States of America," followed by the phrase "To all to whom these presents shall come," and have closed with the usual attestation: "In testimony whereof I have hereunto set my hand and caused the seal —— to be affixed," etc.


The United States of America.

To all to whom these Letters Patent shall come:

AN EARLY UNITED STATES PATENT SIGNED BY WASHINGTON.

Under the act of 1790 the patent recited that "Whereas the applicant has invented" certain things and the invention appears to be "useful and important," . . . "These are, therefore, . . . to grant" to the said inventor, "his heirs, administrators, and assigns, for the term of fourteen years, the sole and exclusive right and liberty of using and vending to others" the said invention. The patent contained only the title and purpose of the invention. There was no specification or drawing forming a part of the document. The statement that the invention appeared to be "useful and important" was to indicate that the invention had been examined by the Secretary of State and the Secretary of War as required by the act. Following the usual clause of attestation, the patent was signed by the President, George Washington, and by the Secretary of State, who at that time was Thomas Jefferson. The seal used was that of the United States. At the foot of the patent was a certification of the Attorney-General, Edmund Randolph, that he had examined the patent and found it conformable to the patent act. The conjunction "and" which appears before "assigns" was changed to "or" in the patents granted under the later acts.

Under the law of 1793 the patent recited that "Whereas" the petitioner "hath alleged that he has invented a new and useful improvement in" (giving the title of the invention), has "made oath," etc., has paid the fee and has "presented a petition to the Secretary of State" . . . "that a patent might be granted," . . . "These are therefore to grant to the said" inventor, "his heirs, administrators, or assigns, for the term of fourteen years, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used the said improvement, a description whereof is given in the words of the said" inventor "himself in the schedule hereunto annexed, and made a part of these presents." Then followed the clause of attestation and the signatures of the President and Secretary of State. As before, the patent was sealed with the seal of the United States and was certified by the Attorney-General to be conformable to law.

It will be noticed that there was no statement that the invention had been examined as to novelty, as in the patents granted under the prior act, for, under the act of 1793, the patents were granted as a matter of right upon petition to the Secretary of State, the same as is done under the British system. Under the act of 1790 the patent did not refer to an oath, as no oath was required, but the patents granted in pursuance of the act of 1793, it will be observed, recited that the inventor had made oath to his inventorship.

The patent had attached to it and forming a part of it a description of the invention, usually in the inventor's handwriting. A drawing was also attached, if two copies of it had been furnished by the applicant, but if only one had been furnished, it was retained in the records of the State Department.

About 1807 the practice was begun of reciting the advantages of the invention at the close of the description, and from 1812 it became customary to close with a paragraph which stated more particularly what the inventor regarded as constituting his invention.

There was no substantial change in the form of the grant of United States patents from 1793 until 1836, except that the language was more conservative, to make it more apparent that the statements of fact were only those of inventor and not of the officials.

The act of 1836 returned to the American system which was inaugurated by the act of 1790, and required that the invention should be examined as to its merits before a patent should issue. It also established the Patent Office as a bureau of the Department of State and created the office of Commissioner of Patents. A seal for the Patent Office was also provided. The patents issued under this act recited the allegations of the petition and oath, the payment of the fee and presentation of the petition. The grant was in the same terms as those used under the act of 1790, and the patent had, as forming a part thereof, a description and drawing of the invention. This act required a particular statement of the extent of the invention, and claims that were more or less crude appeared at the close of the specification. The patent was signed by the Secretary of State, countersigned by the Commissioner of Patents and sealed with the seal of the Patent Office.

When the act of 1849 established the Interior Department and transferred the Patent Office thereto the signature of the Secretary of the Interior was substituted for that of the Secretary of State. Except for the change in the term of the patent from fourteen to seventeen years in 1861, the form from 1836 to 1871 was without change.

The form used at present in granting patents is the one which was adopted in 1871. In this form the previous form is condensed and the statement as to the examination is added.

The grant closes with the clause of attestation and signature of one of the Assistant Secretaries of the Interior, the signature of the Commissioner of Patents, and the seal of the Patent Office. The designation of one of the Assistant Secretaries of the Interior to sign the patents was authorized by an act approved February 18, 1888.

The description and drawing set forth the subject matter of the invention with great clearness, and the claim introduced by the act of 1836 has now become so vital a feature that it is called the life of the patent. While the claim must be supported by the description, the extent of the monopoly depends entirely upon the claim, and the choice of its language is so delicate a matter that the Supreme Court of the United States has said "claim of a patent, particularly if the invention be at all complicated, constitutes one of the most difficult legal instruments to draw with accuracy." EDWIN J. PRINDLE.

United States Patent Office.

WINTON MOTOR CARRIAGES.

Among the notable motor carriages which have been placed upon the market in the last few years are those made by the Winton Motor Carriage Company, of Cleveland, O. The problem which confronted this company when they began their experiments was to produce a motor carriage that would go wherever horses went, and their carriage was given a practical test in running from Cleveland to New York. Our engravings represent the Winton motor surrey and the Winton motor phaeton. The phaeton is a deserved favorite on account of its style, utility, and durability. It weighs 1,400 pounds and the cost of operation is only one-half cent a mile. The driving mechanism is snugly concealed in the body of the vehicle. The motor is of the single hydrocarbon type, simple, powerful, and compact, and is practically free from noise and vibration. The motor is absolutely under the control of the driver at all times and can be run at any desired speed, the motor making from 200 to 1,000 revolutions as is required. The speed of the carriage can be regulated and held at will anywhere from zero to the maximum power of the motor, which is eighteen miles per hour. The carriage is operated by levers, which engage, release, or reverse the driving mechanism and apply the brake. Variable gear for different speeds is not necessary, excepting the hill-climbing and backing gear. The

WINTON PHAETON, SIDE VIEW.

weight and dimensions are accurately proportioned to the power employed, securing the proper traction. Although intended for two, the phaeton will seat three people. It uses common stove gasoline, which can be obtained in any village, and carries a sufficient quantity for a day's run of seventy-five miles. Each carriage is finished in Brewster green, with leather cushions, dash, and fenders, and handsome nickel trimmings. They are also supplied with top, storm apron, lamp, and gong.

The surrey is another handsome vehicle, and is provided with a motor which is more powerful than the phaeton. The company are also about to build a 1,500 pound delivery wagon with variable speed, the motor having an air governor controlled by a foot-button, which regulates the intake.

Electrical Exhibition Notes.

Each of the Electrical Exhibitions held in this city of late years has been distinguished by some special feature. That of 1896 included the best public demonstration of the Roentgen rays, the transmission of power from Niagara, and the sending of a cable message around the world. The Exhibition of 1898 included a complete church lit by vacuum tubes, the application of electricity to street car traction, the first series of waxworks ever made to illustrate the history of an art, the theatrophone, and the beginnings of wireless telegraphy. The prominent feature of the 1899 Exhibition will certainly be automobilism. The exhibit of electric vehicles will be by long odds the largest and best ever seen in America, and second only to the great exhibits of Paris; in fact, in many respects it will surpass the displays of Europe, because it will illustrate particularly the application of electricity, and because the vehicles shown will demonstrate the high perfection that the art has already reached in this country. This degree of excellence is proved by the fact that, while there is no sale for European automobiles here, the manufacturers in America cannot ship machines fast enough to keep up with the demand. This automobile exhibit bids fair to be a sensation in New York, illustrating as it will the wonderfully wide range of application, carriages and wagons of every type being shown, with many special points of novelty and originality. It has been proposed, in connection with this exhibit, to organize during the show an automobile parade, making a characteristic function of it, after the style of those given in Paris through the Bois de Boulogne. It is believed that something of this character will be arranged while the National Electric Light Association is in session. The fact that to central station sources of supply this great new industry must look for the currents which it is to use gives peculiar interest to the situation, automobile plants being already among the largest consumers that central lighting stations have upon their list of patrons. Several thousand square feet will be occupied by the exhibits of a large number of automobile manufacturers, and in this way a convincing proof will be given to the American public that the new industry is fairly launched on its career. The exhibition will be open from May 8 till June 4.

A great many other important features will be brought forward for the first time, and in an improved shape, at the exhibition; but, in view of the intense public interest manifested in wireless telegraphy, the management have undertaken to organize exhibits in that line of work that will be unusually instructive. It will be remembered that, in 1898, mines and torpedoes were exploded in the central tank by wireless telegraph methods, and other experiments of this nature are being planned for this year; but, in order that the public may see the whole operation itself at a glance, and at the same time go away without any lurking suspicion of the genuineness of the feat, it is proposed to exhibit complete working sets of the apparatus on a long table of glass, the table itself being set up and insulated by blocks of glass, so that there will be a clear view under and around the apparatus. This table will be about 15 feet long, and messages will be sent from one end to the other, the sending signals and the response at the receiving end being heard at once. Visiting telegraphers, operators from newspaper offices, and any other spectators will be allowed to send messages or signals themselves. The same

WINTON PHAETON, FRONT VIEW.

apparatus will also be utilized in connection with the experiments for long distance work, and a series of points have been selected between which and the Garden it is proposed to exchange messages. In this manner the public will have a better opportunity than has ever been afforded before of learning for itself the modus operandi of an invention which is stirring up the world of science no less than the outside public fully as much as the Roentgen rays did at the time of their discovery.

Several valuable government exhibits have been secured, and these will be grouped and attractively displayed. They include apparatus from the Army and Navy, the Signal Corps, and the Weather Bureau, and will embrace also not a few interesting electrical relics of the late unpleasantness with Spain.

A special department will also be devoted to electrotherapy—the rapidly widening science of the application of electricity to medicine and surgery, in connection with which a great deal of elaborate apparatus has already been promised. It is the special aim and intention in connection with this exhibit to enable the public to learn for itself how far the science of electricity in the cure and prevention of diseases has gone. The utmost care is being taken to treat the subject on strictly scientific lines, and a committee of eminent specialists has been organized, whose names alone are a sufficient guarantee for the excellence of the work in this department. Another special section will illustrate the great strides made of late years in the application of electricity to dentistry. Here, again, the pervading relationship of the central station to the later branches of electricity will be emphasized, it being a fact that more and more of the practitioners who employ electricity in their work depend upon the power plants for their supply of current, with the intervention of motors and storage batteries.

A number of spectacular exhibits are also being laid out and elaborated by a committee at whose head is Mr. Luther Stieringer, whose work is so well known in connection with the electric exhibits at Chicago, Atlanta, Omaha, etc. This expert has also taken in hand the lighting of the Garden and will produce some entirely new effects, not only beautiful in themselves, but instructive as to the manner in which light should be used for the harmonious illumination of large spaces. A great many of the exhibitors are preparing features of extreme novelty and interest, to which much attention will be called as soon as it is proper to do so.

It is a happy coincidence that this Electrical Exhibition in New York will be in progress at the time the Electrical Exhibition opens at Como, Italy, to celebrate the centennial of the momentous discovery of the electric battery by Volta. The Italian exhibition opens on May 15, and it is proposed, therefore, to hold a special celebration at the Garden on Saturday, May 13, from which fraternal congratulations can be sent by cable. The New York Electrical Society, under whose auspices the exhibition of 1898 was given so brilliantly, has undertaken to reorganize the exercise of this function, and will rally to its aid on the occasion the assistance of other local and national bodies naturally interested in the matter, inviting, also, the co-operation of the Italian officials and societies. President Dunn and Secretary Guy are already at work on this matter, which commends itself generally to all who recognize how great is the debt which is owed to the famous Italian from whose work, it may be said, practical modern electricity dates.

Last year the basement was devoted almost wholly to exhibits of engines and boilers, and apparatus of that class. Although this was very successful, a great many of the exhibitors desired to be on the main floor. This has been accomplished in the present exhibition by General Manager Nathan, and the basement will thus be available for a series of very interesting exhibits of a special nature, each of which will constitute a separate entertainment, and all of which will be free to the public. There will be an electrical theater of scenic models, the theatrophone, an electrical Cave of the Winds, an electrical grotto, an exhibit of the uses of electricity under water, and several other features of equal attractiveness. Such of the space as may not have been used in this way will be thrown open to inventors and patentees, who have meritorious inventions which they wish to introduce to the public, and for which they desire to secure capital for exploitation. All likely to be interested in this opportunity are requested to communicate at once with Mr. Nathan at Madison Square Garden, who will arrange to provide them with a reasonable amount of space for their apparatus, and to assist them in every way to make an attractive demonstration at very small cost. It is believed that many worthy ideas and devices linger in obscurity for want of such an opportunity as this, and the experiment will be given a liberal trial, in order to see what it may bring forth of value and importance.

WINTON MOTOR CARRIAGE—SURREY.

SOME RECENT RESEARCHES ON THE GREAT NEBULA IN ORION.

Under the directorship of Prof. J. E. Keeler, the activities of the Lick Observatory at Mount Hamilton, Cal., with its magnificent 36-inch refractor, have been vastly increased. The wonderful nebula in Orion, one of the most distant and remarkable objects in the terrestrial universe, has been of late the subject of patient and protracted observation by Prof. Keeler, whose conclusions are embodied in the article below, written from information supplied by him and by him carefully revised.

Among the celestial objects which are regarded by astronomers with exceptional interest is the great nebula in the sword handle of Orion. Missed by the acute observer Al Sufi, to whom the nebula of Andromeda was known before A. D. 900, and, singularly enough, by Galileo, it seems to have been first discovered by Cysat, of Lucerne, in 1618. It was independently discovered thirty-eight years later by the eminent Dutch astronomer Huyghens, to whom we owe the earliest of the drawings that have come down to us. Since then it is safe to say that hardly a telescope has been made which has not, at one time or another, been directed to this wonderful object.

Until very recently, the only method of recording the shape of the nebula was that of drawing, by hand and eye, at the telescope. The first drawings were very rough. The positions of the stars in the nebula, as well as the outlines of the nebula itself, were merely sketched in by estimate. It is, moreover, sufficiently obvious that some of the early draughtsmen were by no means proficient in the use of the pencil, though we may concede that their drawings, in the form in which they have been published, owe some of their roughness to the engraver. Later observers conducted their work with more care. They plotted the stars from accurately observed positions, and drew the complex detail of the nebula with reference to the points so obtained. The great reflecting telescopes of Herschel, Lassell, and Lord Rosse were turned upon the nebula of Orion, and in considering the trustworthiness of the drawings made by these eminent observers, and by others with the large refracting telescopes of modern times, the elements of carelessness and lack of skill do not have to be taken into account.

But, in spite of all the care and skill bestowed upon them, these drawings differ greatly from one another. They agree well, it is true, with respect to the Huyghenian region—the bright, sharply defined central area of the nebula—but the faint, diffuse streamers which extend out from it are shown with widely various forms. These differences are due solely to the difficulty of perceiving and depicting such vague, dimly luminous shapes, and arising as they do from the limitations of human perception, they reflect no discredit on the skill of the artist. Of all the drawings that have been published, that which looks most like the actual nebula seen in the telescope is the beautiful picture by Prof. Bond, which forms the frontispiece of vol. v. of the Harvard College Observatory Annals, while the drawing which most accurately represents the forms of the dim, outlying streamers is one made by Lassell, in the pure air of Malta, in the year 1862.

No one would think of making such drawings now. The laborious methods of a few years ago have been superseded by the camera and the photographic plate.

The first photograph of the Orion nebula was taken by Dr. Henry Draper, of New York, on September 30, 1880. Another photograph taken by the same investigator, in 1882, is of great excellence, although it shows only the brighter parts of the nebula. A beginning having thus been made, progress became very rapid. A splendid photograph taken by Dr. Common in 1883, with a three-foot reflecting telescope of his own construction (now in the possession of the Lick Observatory), was awarded the gold medal of the Royal Astronomical Society. Still further advances were made by Pickering, Roberts, and others; and it would seem that the photographic method has now nearly reached its limit, since with still longer exposures the plate is blackened by the general illumination of the sky. By means of these photographs it has been shown that the great nebula is part of a vast nebulous system, which includes a large part of the constellation of Orion.

A photograph taken with moderate exposure is shown herewith, which is not, however, given as a specimen of modern work (since the method of reproduction is entirely unsuitable for such an object as a nebula), but is inserted for convenience of reference and to illustrate some of the remarks which follow. The detail in the central parts of the nebula is almost entirely lost in the process of reproduction.

NEBULA OF ORION PHOTOGRAPHED WITH THE CROSSLEY THREE-FOOT REFLECTOR.

On comparing such a photograph with celebrated drawings, we are struck by some remarkable differences. With respect to the Huyghenian region, photographs and drawings agree very well, but its intensity, as compared with the rest of the nebula, is very much greater in the drawings. This in itself means little, since the amount of contrast on a photograph depends upon the length of exposure, quickness of plate, manner of development, and other circumstances, as well as on the relative intensity of the images which produce the negative. It is easy to obtain a photograph with short exposure which shows the Huyghenian region and nothing else. With long exposures, as all photographers know, contrasts are reduced.

Other differences are, however, less easily explained. Some details (as, for instance, the beautiful curves of nebulosity on the left [west] of the Huyghenian region) are bright and distinct in the photographs, but do not appear at all in the drawings; yet in some cases they appear to be as bright as other features which are easily visible in even a small telescope. Why is this?

To answer this question it is necessary to consider the quality of the light of the nebula as revealed by the spectroscope.

In 1864 Dr. (now Sir William) Huggins, then first applying the spectroscope to the study of such celestial objects, found that the spectrum of the Orion nebula consists of isolated bright lines, among others one or two of the lines of hydrogen. The gaseous nature of the nebula was, therefore, established. Later investigations, chiefly by Sir William and Lady Huggins, Sir Norman Lockyer, and Prof. Campbell, have revealed the existence of a large number of lines, some of which have been identified with lines of hydrogen and helium, while others are of unknown origin. [Prof. Keeler kindly sent a diagram of a spectrum, which it was not possible to publish owing to lack of space. In this diagram the intensities of the lines are represented by varying widths.]

The spectrum of a nebula is regarded with great interest by astrophysicists, because, according to modern views, the stars are evolved from pre-existing nebulæ by a process of condensation. The spectrum of a nebula is, therefore, the starting point of systems of stellar classification, and is of fundamental importance. A few years ago it was independently discovered at the Lick and Allegheny Observatories that all the principal lines in the spectrum of the Orion nebula (with two notable exceptions) are represented by dark absorption lines in the spectra of the stars which are involved in the nebula, and of other stars which belong to the same great nebulous system. In other respects the spectra of the same stars are nearly blank. An intimate relation between the stars and the nebula is, therefore, proved beyond all reasonable doubt.

The two lines which have been noted as exceptions to the statement made above are the two lines which are generally most easily seen in the spectrum of a nebula. One is the so-called "chief" line, $\lambda 5007$ (that is, the line whose wave length is 0·5007 thousandths of a millimeter); the other is the "second" nebular line, $\lambda 4959$. These lines can be readily identified in the diagram of the spectrum by means of a wave-length scale placed above the spectrum.* They seem never to be reversed under any circumstances.

A very important discovery was made in 1893 by Prof. W. W. Campbell, of the Lick Observatory, Mount Hamilton, California. Previously to that time it had always been supposed that the visible spectrum of the Huyghenian region was essentially the spectrum of all parts of the nebula. Prof. Campbell, employing a spectroscope attached to the great 36-inch telescope, found that the relative intensities of the three brightest lines changed greatly when he moved his spectroscope slit from one part of the nebula to another. Thus, while in the Huyghenian region the intensities of the lines $\lambda 5007$, $\lambda 4959$ and $H\beta$ were respectively as 4 : 1 : 1, in the neighborhood of the star Bond 734 (shown herewith, surrounded by nebulosity, below the main nebula) they were as 4 : 1 : 20. In general, the hydrogen spectrum was relatively strong in the fainter parts and outlying regions of the nebula.

The significance of these observations has recently been questioned, on the ground that they admit of a physiological explanation. By what is known as the "Purkinje effect," the position of maximum brightness in a spectrum shifts toward the violet end when the

THE CROSSLEY THREE-FOOT REFLECTOR OF THE LICK OBSERVATORY.

* The last two ciphers are omitted for economy of space.

light is weakened, even though its quality remains the same. If, therefore, we suppose that two lights, one red and one blue, appear equally bright when the intensity has a certain value, the blue one will appear the brighter when the intensities are equally diminished and the red one will appear brighter when they are increased. On lowering the brightness sufficiently the blue light will even remain visible after the red one has disappeared.

It will be observed that the Purkinje effect acts in the right direction to explain the observations of Campbell, since it was the blue line $H\beta$ which appeared relatively brighter in the faint parts of the nebula, but it seemed very doubtful whether it was competent to explain the amount of the observed differences. The lines observed by Campbell were not at opposite ends of the spectrum, but were close together, all being in the bluish green. The physiological effect must have been small, yet the observed variations of the $H\beta$ line were as much as 20:1. Careful observations made at the Lick Observatory during the past winter have shown that these variations are in fact real, and cannot be explained on physiological grounds.

The non-homogeneity of the Orion nebula must, therefore, be regarded as proved. The substances (or substance) yielding the chief and second nebular lines are more particularly concentrated in the Huyghenian region; in the faint and remote regions hydrogen predominates.

It may be admitted that this non-homogeneity of the nebula may be only apparent, that the substances of which the nebula is composed may be distributed in the same proportions throughout its whole extent, and on account of differences of temperature, density, etc., the spectrum is not everywhere the same; but the fact remains that the quality of the light emitted by the Huyghenian region differs from that emitted by the outlying parts, as if the materials themselves were distributed in the manner already stated.

When this non-homogeneity of the nebula was discovered, it was pointed out by Prof. Keeler, then director of the Allegheny Observatory, that it would necessarily cause a difference between drawings and photographs; for the light from the diffuse hydrogen streamers, though strongly actinic, would scarcely affect the eye. The nebula is seen by one set of rays and photographed by a different set, so that the two impressions cannot be expected to agree unless these sets of rays are emitted in like proportions by all parts of the nebula. This is not the case; and only the amount of the differences thus produced can be called in question.

Prof. Keeler proposed a method for testing this point, and for producing photographs directly comparable with drawings, which he successfully put in practice last winter at the Lick Observatory. The method consisted in photographing the nebula, through a ray filter or color screen, on an orthochromatic plate. The color screen, which had to be chosen with special reference to the nature of the spectrum of the nebula, was of a light green color. It completely suppressed the entire spectrum of the nebula, down almost to the $H\beta$ line, transmitting, therefore, only the lines which are recognized by the eye. By means of orthochromatic plates sensitive to green light the nebular lines $\lambda5007$, $\lambda4959$, and $H\beta$ were rendered with nearly their proper visual relative intensities. The image of the nebula photographed through the color screen, in this way, was therefore practically identical with the image which is seen in the telescope in ordinary observation.

The instrument which was used was the three-foot reflecting telescope already referred to as having been made by Dr. Common. This telescope had come into the possession of Mr. Edward Crossley, of Halifax, England, who presented it to the Lick Observatory; and through the offices of Dr. Holden, the former director, it was transferred to California and set up on Mount Hamilton.

The Crossley reflector is a very effective photographic telescope. The Huyghenian region of the Orion nebula can be photographed on an ordinary plate in thirty seconds, and an exposure of five minutes shows a large amount of the surrounding nebulosity. Nevertheless, so feeble is the actinic power of the rays transmitted by the color screen, that the exposures had to be increased from thirty to fifty times to obtain corresponding results when the screen was used. The correct ratio of exposures having been ascertained by experiment, two photographs were taken on the same night, one on an ordinary plate and the other through the color screen on an orthochromatic plate. In order to secure comparable negatives, the two plates were developed together. A considerable number of such photographs was made.

The result of the investigation was that the earlier spectroscopic observations are confirmed and extended, and that the most obvious discrepancies between photographs and drawings are explained. The photographs taken with the color screen are in much better general agreement with drawings than are ordinary photographs. Thus the Huyghenian region is relatively very strong, while the features which have been referred to as abnormally strong on an ordinary photograph, as, for instance, the nebulosity surrounding the star Bond 734 and the nebulous curves west of the Huyghenian region, are much reduced.

Another example of particular interest is the following: The long, scimiter-like streamer, extending upward (south) from the Huyghenian region, is easily visible in small telescopes. It was discovered by Messier in 1771, and is known as the Messerian branch (see Fig. 1). It is, of course, represented in all the drawings. Just to the left of the Messerian branch, and running parallel to it, is a shorter streamer, which is not easily seen, even with large telescopes, and is not shown on any drawing except Lassell's drawing of 1862. Yet on an ordinary photograph these two streamers have nearly equal strength (Fig. 1). The explanation as given by the orthochromatic photographs is, that the lowest nebular lines are strong in the spectrum of the Messerian branch and very weak in that of the companion streamer.

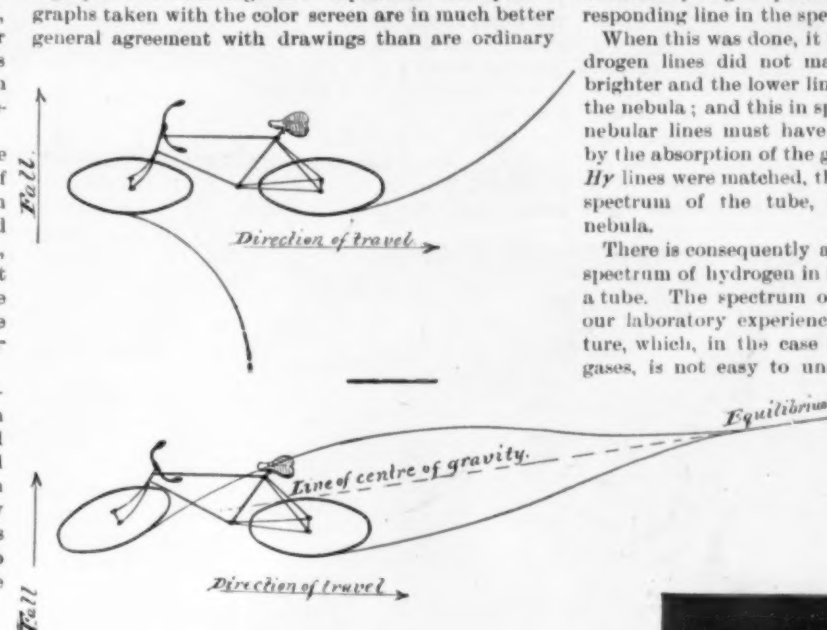
The question has been raised whether the spectrum of hydrogen given by the nebula of Orion is identical with the spectrum obtained from hydrogen in our laboratories, and, incidentally, why it is that the red hydrogen line, $H\alpha$, cannot be seen in the spectrum of the nebula. Prof. Scheiner, of Potsdam, has shown that a hydrogen tube cooled down to −200° C., and excited by feeble electric waves, gives the same spectrum as it does at ordinary temperatures. We cannot suppose, therefore, that the spectrum of the nebula is influenced by the cold of space.

Prof. Scheiner very plausibly explains the invisibility of the $H\alpha$ line as a consequence of the Purkinje effect. A simple observation due to Mr. W. H. Wright, Assistant Astronomer at the Lick Observatory, seems to show, however, that some other than physiological causes are also concerned in this peculiarity of the nebular spectrum.

The great telescope, carrying a spectroscope, was directed to the nebula of Orion, and the light from a hydrogen tube was thrown into the spectroscope, so that the two spectra appeared side by side. The hydrogen tube was mounted on a long slide in such manner that, by simply changing its distance from the slit, the brightness of its spectrum could be altered, while the quality of the light, of course, remained the same. It was thus easy to adjust the tube until any line of the artificial hydrogen spectrum exactly matched the corresponding line in the spectrum of the nebula.

When this was done, it was found that the other hydrogen lines did not match, the upper lines being brighter and the lower lines fainter in the spectrum of the nebula; and this in spite of the fact that the upper nebular lines must have been considerably weakened by the absorption of the great object glass. When the $H\gamma$ lines were matched, the $H\alpha$ line was visible in the spectrum of the tube, though not in that of the nebula.

There is consequently a real difference between the spectrum of hydrogen in the nebula and hydrogen in a tube. The spectrum of the nebula, interpreted by our laboratory experience, indicates a high temperature, which, in the case of such enormously rarefied gases, is not easy to understand. We may suppose that the light of the nebula is excited by electrical disturbances, in which case the temperature of the gases may be low; but of these electrical disturbances we have no independent knowledge. The problem is one of many which still await solution.



Method of Regaining Equilibrium.

Regaining the Balance.

Retaining the True Balance.

The Two White Cords show the Axis of the Head and the Point of Contact of the Wheel.

THE PRINCIPLE OF RIDING THE BICYCLE BACKWARD.

RIDING A BICYCLE BACKWARD.

BY E. J. PRINDLE.

A study of the mechanics of the bicycle is very interesting; for the safety bicycle is a wonderfully perfect machine when considered in relation to the purpose for which it was intended; in fact, it is one of the most perfect solutions of a mechanical problem that has ever been devised. So perfect is the safety bicycle, in fact, that, if the rider has sufficient skill not to interfere with its action, it will travel straight ahead and keep its own balance. The perfection of its design is, perhaps, most easily seen by an analysis of the various ways of riding the bicycle.

To explain the manner of balancing and steering by controlling the front wheel, it is not necessary to go very deeply into the structure of the bicycle. A rider loses his balance when his weight is not over a line connecting the points of contact between the wheels and the ground. To regain his balance, he turns his front or steering wheel in the direction in which he is falling, thus causing the line of contact of the wheels and ground to pass sideways in the direction of the fall until it is again under his center of gravity.

To steer to one side, the rider should throw his

weight to the side toward which it is desired to go. The front wheel is also turned in this direction, and the tendency to fall is counterbalanced by the constant travel of the points of contact of the wheels with the ground in the direction of inclination. Equilibrium is thus maintained during the turning. When it is again wished to go straight, either the weight is shifted to the opposite side (by leaning) or the front wheel is turned still sharper, as in restoring the balance.

In examining the mechanics of the more difficult features of bicycle riding, it is necessary to consider with more particularity the laws governing the action of the front or steering wheel. The front wheel is mounted on an axle which supports a fork whose stem has a bearing in a rearwardly inclined position in the head of the frame. The fork curves forward as it approaches the axle. If the stem were vertical and the fork straight, the axis of the stem would meet the ground at the point where the wheel rests on the ground. The inclination of the fork stem, however, causes its axis to pass in front of the point of contact of the wheel and ground, thus producing the effect of the caster wheel, such as is used on furniture. The curve in the fork brings the point of contact of the wheel closer to the axis of the stem, and, without destroying the caster action, increases the sensitiveness of the steering wheel. The chief effect of the caster construction is that the point of contact of the wheel, by dragging behind the axis of the stem, exerts a strong tendency to keep the wheel pointed in the direction of motion of the bicycle.

If the stem axis be kept in the vertical plane through the axle, there is no tendency of the wheel to turn to the side when the stem is inclined laterally. When, however, the stem is not kept in this vertical plane and is inclined toward a given side, the wheel turns toward that side until its axle is in the vertical plane passing through the stem. The reason for this lies in the tendency of every body that is free to move to seek the position in which its center of gravity is lowest. In such a position of the wheel, the distance from its center to the ground is less than its radius.

Applying this law to the construction of the bicycle, the inclination of the stem axis tends, when the frame is vertical, to turn the steering wheel across the frame. As the frame is tipped further the wheel turns toward the front until, when the frame lies on the ground, the wheel is practically in line with the frame. The wheel turns to the side toward which the frame leans, and this is because the axis of the stem, passing to the rear of the axle, leaves the center of gravity of the wheel in its front.

There are, therefore, two forces acting on the unrestrained steering wheel. First, there is the caster action, which tends to keep the wheel in line with the frame; and, second, there is the tendency of the wheel to turn to the side toward which the frame is inclined and throw the axle into the vertical plane passing through the stem axis. The position which the wheel takes is one due to the resultant of these two forces.

In riding straight ahead with the steering wheel unrestrained, if the balance is lost, the steering wheel, owing to the inclination which the stem axis thus receives, turns in the direction of fall and carries the line of contact of the wheels with the ground laterally until it has passed under the center of gravity of the rider and wheel, when the frame either remains straight or inclines in the opposite direction. In the latter event the steering wheel again automatically restores the balance.

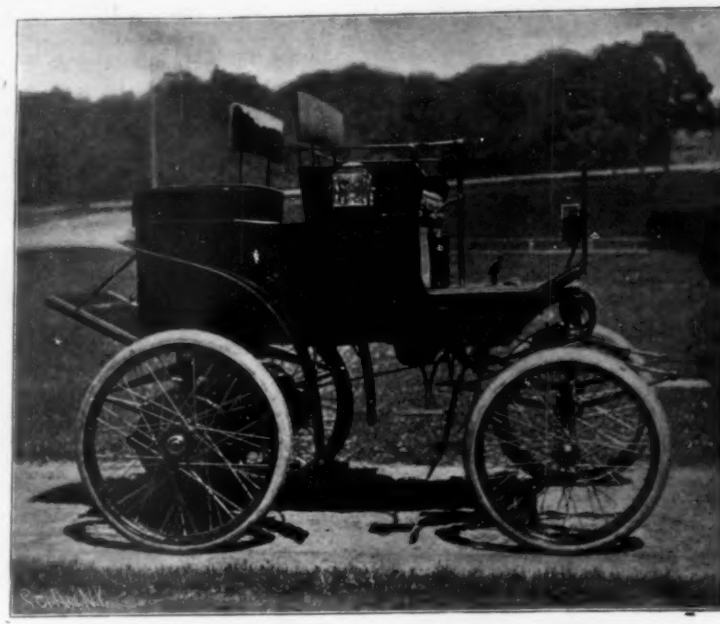
If the rider, when running with hands off, desires to turn to one side, he leans to that side; and the steering wheel turns itself in the same direction. When the turn has been made, the rider leans in the opposite direction until the front wheel has again placed itself in line with the frame.

The acts thus far enumerated are commonly performed; but the feat of riding backward is much more difficult and rare. That this can only be done by manipulation of the steering wheel will be apparent from the following considerations:

In riding backward with the steering wheel free, the point of contact of this wheel drags and seeks to move, relative to the frame, away from the direction of travel. It accordingly approaches the stem axis, turning the wheel across the frame. The steering wheel remains in this position, because it is the position of lowest center of gravity, and because the point of contact cannot go beyond the stem axis. Owing to the position of the center of gravity of the steering wheel in front of the stem axis, the wheel will fall to the side toward which the frame is inclined and will cause the head to run away from the direction of fall, instead of in the same direction as the fall, as it does in riding forward. It is therefore apparent that the bicycle cannot be ridden backward when the steering wheel is allowed to control itself.

Let us see what can be done by manipulation of the steering wheel. If perfect balance could be maintained, the bicycle would travel in a straight line and no trouble would occur. In actual practice, however, the bicycle is always falling either to one side or the other. Suppose it to fall to the right side. The driving wheel, which is now the front wheel, being inclined to the right, will travel in a curve toward the right, as does a coin when it is rolled freely across the floor. The driving wheel is consequently going in the proper direction to carry the line of contact under the center of gravity and restore equilibrium. If, then, we turn the steering wheel so that it travels to the right, the bicycle will travel bodily in the direction of fall, and if this takes place more rapidly than the center of gravity travels laterally, equilibrium will be restored.

The secret of recovering the balance in riding backward lies in turning the steering wheel in the opposite direction relative to the direction of travel of the machine from that in which it is turned when riding forward. Having once learned to turn the handlebar one way in riding forward, it is very difficult to turn it in the opposite direction merely because the bicycle is traveling backward.



COLUMBIA TWO-SEATED "DOS-A-DOS" MOTOR CARRIAGE.

COLUMBIA TWO-SEATED "SURREY" MOTOR CARRIAGE.

COLUMBIA MOTOR CARRIAGES.

The three motor carriages herewith illustrated were chosen from the many styles of automobile turned out by the Pope Manufacturing Company as being thoroughly representative of the work done in the motor carriage department of this firm. In every case the motive power is electricity, the company being of the opinion that in the present state of the art electricity, while not without its limitations, fulfills more of the necessary conditions of a successful motive power than the steam or gas engine.

The storage electric motor is clean, silent, free from vibrations, thoroughly reliable, easy of control, and produces no dirt or odor. While it is not so cheap nor of such mileage capacity as some other forms of motor, it is certainly not extravagant in proportion to the service rendered, and its capacity has been proved to be more than equal to the demand of the average city or country vehicle. The greatest demand for an efficient automobile comes, not from people who wish to take long tours through the country, or whose business calls them to any considerable distance from an electric charging station, but from surgeons, expressmen, and those private citizens who wish to keep a carriage, but cannot afford either the space or the cost entailed in providing a team, stable, and coachman.

In order to secure data as to the necessary mileage to be provided for in the storage batteries, the Pope company had cyclometers attached to the conveyances of several individuals who were engaged in occupations in which the automobile would prove serviceable. The investigation showed that the average mileage was 18 miles per day, and except in one case the maximum mileage did not exceed 25 miles. Accordingly, batteries are furnished for the motors that have a capacity of 30 miles per day on level roads and 25 miles on the ordinary grades of a New England city. These figures are, of course, modified by conditions of mud, snow, or rocky roads. The batteries can be charged from any 110-volt direct current circuit such as is used in city lighting. Where current of a higher voltage or the

COLUMBIA DOUBLE-SEATED "PHAETON" MOTOR CARRIAGE.

alternating current is used the company supply, at moderate cost, a small portable and practically automatic transformer. To charge the batteries from empty to full takes three hours, and the average cost, where current is taken from the city mains, is 60 cents, and the company claims that the average cost of running on a carriage when using current taken from a public station is one cent per mile.

The frame is built of steel tubing manufactured at the Hartford establishment. The wheels are proportioned to meet the specially severe strains of motor carriage service, the front wheels being ordinarily 32 inches in diameter and the rear driving wheels 36 inches. The tires, 3 inches in diameter, are of the Hartford single-tube type, and are provided with a roughened "herring-bone" tread to improve the adhesion. The walls of the tube are of great thickness, and one set of tires has already run 2,500 miles without the need of repairs. The wheels are fitted with ball bearings designed to meet the heavy loads and stresses of the automobile.

The carriages have a maximum average speed of 12 miles per hour on the level, and they can be run at lower speeds of 6 and 3 miles an hour if desired. These speeds are based upon the fact that 8 miles per hour is the legal limit in most cities. The person operating the carriage sits on the left hand side, as this is the convenient side for seeing the wheels of any passing vehicle and judging the distance. The controller, which moves through four positions, from "stop" to "full speed," is at the left hand, and the steering handle is held in the right hand. The brake and reversing lever are operated by the left foot. The brake consists of a bronze band which is tightened over an iron drum on the rear or driving axle. A warning electric bell is carried on each carriage. It is rung by pressing a push button placed in the end of the controller handle already mentioned, and a meter is conveniently placed in sight of the operator, by which he can read at sight how much of the battery power has been used.

EXPLOSION OF A TEN-INCH GUN AT SANDY HOOK.

MR. HUDSON MAXIM REPLIES TO MR. HIRAM S. MAXIM.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 6, 1899, appeared a long article signed "Edmund J. Ryves" and another signed "Hiram S. Maxim." All who are familiar with Hiram S. Maxim's style of expression will be able to identify both communications as the work of the same author.

My brother Hiram, in his letter, states that I did not assist him in his early experiments on smokeless powder in England. The same statement is also made in the Ryves article. I have letters in my possession signed by Hiram S. Maxim in which he states that I did assist him very materially in those experiments, which I shall publish in the next issue of the SCIENTIFIC AMERICAN SUPPLEMENT. I am glad that he now claims that I did not assist him in those experiments, because this refutes his previous claims that the inventions which I have patented were on ideas acquired by me from him while assisting him in his experiments.

He also states that an examination of the patents will show who the patentee really was. I will also state that an examination of the patent records will show which of us, Hiram S. Maxim or myself, is the inventor of the most important inventions now used in the commercial manufacture of smokeless powders. The following is a list of my British smokeless powder patents: No. 18,682 of 1894; No. 8,569 of 1895; No. 11,299 of 1895; No. 16,311 of 1895; No. 16,861 of 1895; No. 16,862 of 1895; No. 16,858 of 1896; No. 15,499 of 1897; No. 7,178 of 1897.

The following letter from Dr. Robert C. Schupphaus will explain itself and throw considerable light upon the matter under discussion here.

"Charlottenburg, Germany, September 17, 1898.

"Hudson Maxim, Esq., New York city:

"Dear Sir: Your letter of August 30 was received, telling me of the statements made by Mr. Hiram S. Maxim about smokeless powders, and his claims to being the inventor of important methods and processes, and his further assertion that many of the important features of the Maxim-Schupphaus smokeless powder originated with him and were taken from him.

"I have been long aware that he was making some such claims. In fact, in the fall of 1896 I was told in London, by Mr. Albert Vickers, that he had understood from Mr. Hiram S. Maxim that all the important methods employed by us were taken from him, and that they were his inventions. Mr. Hiram S. Maxim was forced to acknowledge before Mr. Albert Vickers, in my presence, that any such conclusion in regard to the Maxim-Schupphaus powder as Mr. Vickers might have arrived at through remarks of his was false, and that not a single feature of this powder originated with him. I have in my possession a letter addressed to me and signed by Mr. Albert Vickers, for Vickers Sons & Company, Limited, dated London, November 2, 1896, which closes as follows:

"'We undertake not to manufacture this powder without having made an arrangement satisfactory to yourself.'

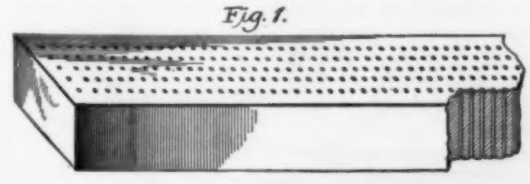
"Anybody who is familiar with the history of smokeless powder and the actual processes of manufacturing these powders knows that none of Mr. Hiram S. Maxim's inventions is being used to-day in the commercial production of any smokeless powder in the world.

"You may give any publicity you wish to this letter in order to meet the unfounded claims made by Mr. Hiram S. Maxim and also to show that, as we stood together and shared the work and the trials in the production of the Maxim-Schupphaus smokeless powder, there is now no disposition on the part of either of us to rob the other of the full measure of credit deserved, and we stand together in sharing the credit as we did in sharing the work. Sincerely yours,

(Signed) "ROBERT C. SCHUPPHAUS."

One such letter, referring to his first smokeless powder experiments, was addressed to Lieut. J. F. Meigs, Engineer of Ordnance, Bethlehem Iron Works, Bethlehem, Penn., dated 32 Victoria Street, London, S. W.,

Fig. 1.



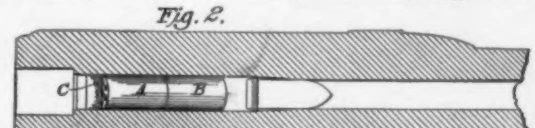
August 8, 1895, in which Hiram S. Maxim makes the following statement:

"My brother Hudson assisted me in my experiments for several months."

In the article signed "Edmund J. Ryves" a statement is made to the effect that the company could not get some of the Maxim-Schupphaus smokeless powder for tests in England, owing to the fact that it was found impossible to make it stand the British stability test. In regard to this, I will refer to Mr. Hiram S. Maxim's remarks on the stability of this powder from his letter to Lieut. Meigs, which will appear in the next issue of the SCIENTIFIC AMERICAN SUPPLEMENT. He says that, according to his own tests, the Maxim-Schupphaus smokeless powder stood twice as long as British cordite.

Last year I sold to Sir William Armstrong, Whit-

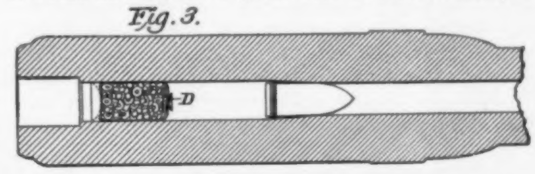
Fig. 2.



worth & Company, eight hundred pounds of Maxim-Schupphaus smokeless powder. They encountered no such difficulty.

It is also stated that: "Mr. Hudson Maxim attributes the disaster to the charge being driven forward into the narrow neck by the pressure, where the grains of powder were jammed together, and an exaggerated illustration is shown with the grains of powder driven forward and jamming in the neck of the chamber. Now, as a matter of fact, in all large guns of modern make, the chamber is very little larger than the bore, the chamber not being bottle-necked to any considerable extent. Mr. Hudson Maxim proposes as a remedy that long bars or sticks of powder should be employed extending the entire length of the chamber, and that these sticks should be transversely perforated. Had the artillerists of the world, who have been experimenting during the last eight years with smokeless powders, exchanged the results of such experiments, it would have saved a great deal of trouble and pre-

Fig. 3.

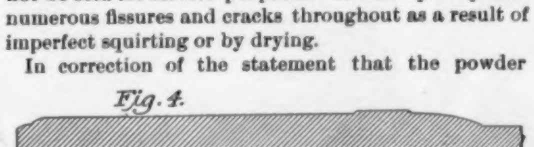


vented a considerable loss of life. This multiple-perforated smokeless powder was tried in my presence over two years ago."

Now, as a matter of fact, the tests which he refers to as having been made in his presence were with ordinary cordite, very irregularly and badly perforated with ragged transverse holes. What I had advised was rods especially made, like that shown actual size in Fig. 1, and 18 inches long and rectangular in form, multi-perforated with small rectangular holes regularly spaced, so as to provide uniform burning thicknesses between the perforations. Furthermore, the cordite which was used was a waste lot which could not be sold for service purposes. It was split up into numerous fissures and cracks throughout as a result of imperfect squirting or by drying.

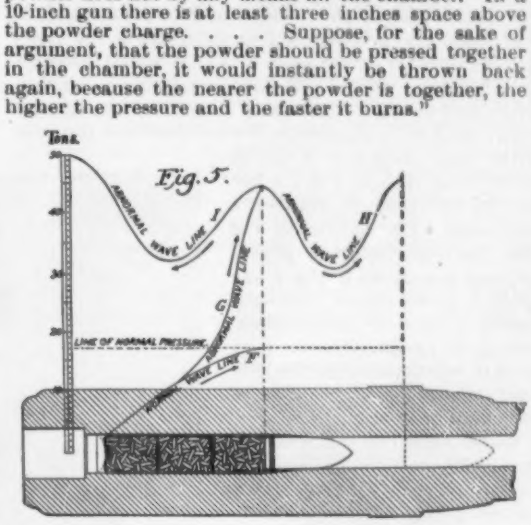
In correction of the statement that the powder

Fig. 4.



chamber in all large guns of modern make is very little larger than the bore, I will call attention to the fact that with the 10-inch gun which burst, the powder chamber was a little more than one-third larger in cross sectional area than the bore, so that a body which would pass freely through the powder chamber would have to be compressed one-third in order to pass through the bore. This is sufficient to account for all I have claimed. I will also quote the following paragraph:

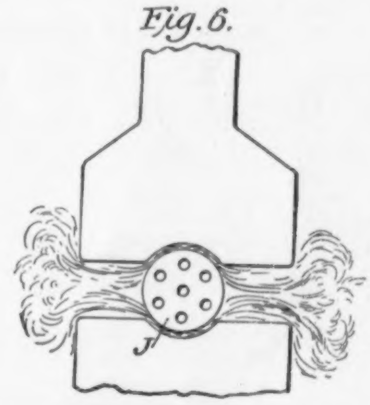
"Now, in regard to the packing or jamming of the powder in the bottle neck of the chamber, this is absolutely impossible. If two sticks of powder are placed in contact and lighted, the evolution of gas from their surfaces is such as to blow them apart. When a large gun is loaded with smokeless powder, the bundle of powder does not by any means fill the chamber. In a 10-inch gun there is at least three inches space above the powder charge. . . . Suppose, for the sake of argument, that the powder should be pressed together in the chamber, it would instantly be thrown back again, because the nearer the powder is together, the higher the pressure and the faster it burns."



Diagrams are shown with an attempt to prove that, owing to the rapid evolvement of gases from the surface of the burning grains, they could not be jammed into the forward end of the powder chamber or crushed; and it is stated that "no amount of pressure will bring two pieces of burning powder into actual contact," and that powder grains in a gun automatically space themselves, contact being rendered impossible, and that 100 tons pressure to the square inch would not force two pieces of burning powder together.

Let us examine this logic. It is not necessary that the grains of powder should come into actual contact in order to produce the jamming, crushing, and bursting effect described by me. The very fact that the pressing together of burning powder grains causes them to be still more strongly forced apart, accords with, instead of being contrary to my claims; for, from that very reason, a higher mounting of pressure and more rapid

Fig. 6.

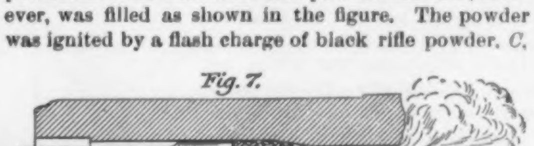


combustion would occur in the narrow neck of the powder chamber, exactly as I pointed out as having occurred in the 10-inch gun which burst. Also witness statement of Mr. Hiram S. Maxim in letter to Lieut. Meigs above referred to:

"With a soft and semiplastic powder in long rods, like the British cordite, it sometimes occurs that the explosion produces a wave action, driving the soft and plastic powder, while still burning, into the forward end of the chamber of the gun. . . ."

There was not, as stated in the Ryves article, at least 3 inches space above the powder charge; 141 pounds of powder was employed, considerably more than the normal charge. The entire powder chamber was filled, as shown in Fig. 5, the grains lying helter-skelter. I understand that, by shaking the powder in the bags very hard, it is possible to get a few more pounds of powder into the chamber. The powder chamber, however, was filled as shown in the figure. The powder was ignited by a flash charge of black rifle powder, C, placed at the rear. Now, to arrive at a correct understanding of what probably occurred, let us suppose that two solid cylinders of powder filling the powder chamber were to be employed, as shown in Fig. 2, and a flash charge, C, employed to ignite them. They would be thrown violently forward into the narrow neck of the powder chamber, and the forward one would be crushed, and although the pressure at the rear of the first grain would be rapidly mounting, still the pressure in the confined space about the fragments of the forward grain would cause the pressure to

Fig. 7.



mount much more rapidly, and the whole charge would again be thrown violently backward, to be again thrown forward by a greatly magnified rear pressure.

In the early experiments with prismatic powder in the United States, and which were very extensive, it was found that a charge but partially filling the powder chamber, as shown at *D*, in Fig. 3, would produce very high and erratic pressures, sometimes mounting to seventy or eighty thousand pounds to the square inch; whereas, if the powder were divided and put into three bags, lying end to end, as shown at *E*, *E*, *E*, in Fig. 4, a low and uniform pressure was always the result. The conclusion was that the charge when employed in the shape shown in Fig. 3 was ignited, it was thrown violently forward, more or less crushed, and again backward, setting up violent wave actions of the products of combustion resulting in very high pressure.

When the charge in the 10 inch gun which burst was ignited, it tended to rush forward like a rocket, to follow the projectile out of the gun, but the impacting of the forward end of the charge into the contracted neck of the powder chamber and against the projectile crushed a portion of the grains, and increased the rapidity of combustion enormously, so that the pressure, instead of mounting on the normal wave line, *F*, shown in Fig. 5, rose to an enormous height, on a line something like *G*. This was followed by a wave of reaction on lines something like *I* and *H*, the projectile having in the meantime moved some distance forward. The wave, *H*, impacting upon it, although it rose very high, did not rise to the height of the wave, *I*, which, impinging upon the stationary breech block, and aided by the accelerated combustion of the powder under its influence at the rear, rose beyond the strength of the gun, blowing out the breech with great violence.

As an illustration of the erroneous claim that the powder grains would not be crushed because not capable of being brought in actual contact, let us refer to Fig. 6. Suppose a powder grain, *J*, were to be ignited on the anvil of a steam hammer. When the hammer descended, it would not come in contact with the burning grain. This would be impossible, yet I think no one will doubt that the grain would be crushed all the same.

To carry this illustration a little farther, let us suppose that a large number of grains be placed in a hollow cylinder with a contracted opening similar to that of the powder chamber and bore of a gun, as shown in Fig. 7. Let us ignite the charge and instantly bring forward with great violence a steam plunger, *K*; would not some of the powder grains be crushed into fragments in being pushed forward into the contracted space?

A similar condition certainly existed in the 10-inch gun that exploded, only the powder charge was thrown forward and compressed in to the narrow space with enormously greater violence than could possibly be effected with a steam plunger.

In closing, I will add that "collodion" cotton is not employed in the Maxim-Schupphaus smokeless powder, and never has been, as stated in the said article. Neither is the soluble guncotton which we do employ unstable. Soluble guncotton is now made which is as stable as tri-nitro-cellulose and contains nearly as much nitrogen. There is, furthermore, hardly any difference in the explosive value of our gelatin guncotton and tri-nitrocellulose. The powder charge did not detonate in the 10-inch gun which burst, as only the breech mechanism was blown out. The body of the gun was not disrupted. Had the charge detonated, the entire rear portion of the gun would have been blown to fragments.

The charge which burst the 10-inch gun was ignited at the rear. Had it been ignited simultaneously throughout, there would not have been any excessive pressure. The Maxim-Schupphaus multi-perforated cylinder which has been adopted by the United States government is not in any sense a failure, but the biggest kind of a success. I recommend transversely perforated grains, because I believe them a still greater improvement. Nevertheless, the present multi-perforated cylinder only requires proper loading to give perfect results. The same is equally true with cordite and all other forms of gunpowder. The powder which burst the 10-inch gun had undergone no chemical change whatever.

The United States government would not have benefited by the suggested "interchange of experiments." The experiments conducted with the Maxim-Schupphaus powder in this country have been very exhaustive, and the results attained with it are far superior in every respect to anything that has been produced elsewhere in the world, and there have been fewer accidents.

Results of experiments with multi-perforated cylinders have shown greater uniformity in velocities and pressures under all circumstances than have been attained by any other form of powder in the world. In many instances, the velocities and pressures during a large number of shots have been practically as uniform as the instruments could measure. The United States government will not abandon multi-perforated powder grains, but instead, other governments must soon follow the lead of the United States in the use of the multi-perforated smokeless powder.

In confirmation of the above statements about the ballistic value of the Maxim-Schupphaus powder, I refer to the report of the Chief of Ordnance of the United States Army, of 1896, page 197. After dwelling upon the numerous advantages of this form of powder, the conclusion is reached that:

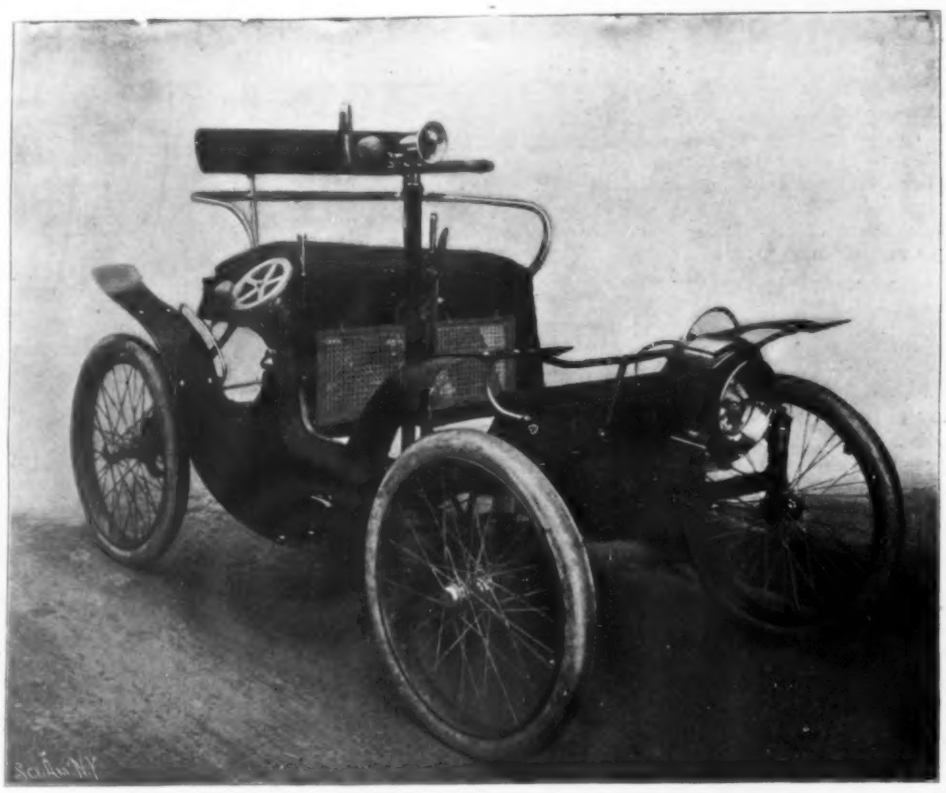
"All things considered, the perforated cylinder or disk proposed by General Rodman many years ago, and recently revived in the Maxim-Schupphaus powder, appears to me to be the most suitable and promising form for the colloidal smokeless powders."

HUDSON MAXIM.

219 West Thirty-fourth Street, New York.

THE DECAUVILLE MOTOR-CARRIAGE.

In the 1898 automobile race from Paris to Amsterdam, a distance of 1664 kilometers (1023 miles), the first prize in its class was won by the Decauville "voiturelle," in fifty-four hours.



FRONT VIEW OF THE DECAUVILLE PETROLEUM MOTOR-CARRIAGE.

The Decauville carriage is driven by a two-cylinder, four-cycle gas engine of the Otto type. The motive agent employed is naphtha, contained in two vaporizing-chambers or carbureters of a capacity to enable the carriage to run fifty miles without replenishing its supply. The air admitted to these chambers forms, with the naphtha vapor, an explosive mixture which is conducted to the cylinders. As in the De Dion-Bouton motor tricycle, the naphtha is prevented from cooling by evaporation, by conveying a part of the hot, exhausted gases through a small tube passing through the carbureters. The two cylinders of the motor have external flanges or ribs so as to obtain a large radiating surface and to prevent overheating. The mixture of air and gas is exploded by means of an electric spark. The pistons are single-acting trunk-pistons, which drive the rear axle of the carriage by means of gearing.

The engine, as before mentioned, is of the four-cycle type. When a piston descends, the intake is opened and the explosive mixture of air and vapor is admitted into the cylinder. When the piston rises, the intake closes and the gas is compressed. Just as the piston is about to descend for the second time, an electric spark explodes the gaseous mixture and drives the piston suddenly down. On the following up-stroke the exploded gases are exhausted. When the first cylinder is in its third period (that of explosion), the second cylinder begins its first period (that of admission), so that the two pistons act alternately on the motor shaft.

REAR VIEW OF THE DECAUVILLE PETROLEUM MOTOR-CARRIAGE.

The accompanying illustrations represent two views of the automobile. Beneath the front edge of the carriage-seat three small levers are mounted, which, by means of connecting mechanism, respectively control the admission of gas to the cylinders, regulate the time of ignition, and control the compression. Like all gas engines, this motor must be started by hand; for which purpose a crank wheel is mounted on one side of the carriage. A lever mounted below the crank wheel on the side of the carriage controls the admission of air to the vaporizing chambers, and, therefore, regulates the carburization. By means of a pedal in the floor of the carriage and a long lever mounted in front of the driver's seat, the motor can be thrown in and out of gear with the rear axle.

The carriage is provided with two changes of speed and is steered by means of a handle bar in front of the seat. The automobile weighs about 500 pounds and has a maximum speed of 20 miles per hour. This handsome vehicle has recently been imported to this country by Mr. P. Cooper Hewitt, of New York, and it is now being tested.

IN three years the cost of running an Atlantic steamer exceeds the cost of construction.

THE DE DION-BOUTON TRICYCLE.

Nowhere has the development of automatically propelled vehicles reached a more advanced stage than in France, where, on account of the fine roads and pavements, the most favorable conditions are found for their operation. Carriages and tricycles operated by gasoline motors are now among the ordinary sights in the streets of Paris. Among the latter the tricycle De Dion-Bouton is most extensively in operation, and may be considered as typical of this class of vehicles.

The motive power used is that of a small hydrocarbon motor, operating on the same principle as the gas-engine, the gas being furnished by the evaporation of gasoline contained in a vaporizing chamber, and then mixed with air to form an explosive mixture, which is then conducted to the chamber of the motor, and which by its explosion at proper intervals operates the piston.

The action of the motor will be seen by referring to the diagram shown in Fig. 1. To the left is the vaporizing chamber or carbureter, in which the gasoline contained in the lower half is brought into contact with the air entering by the tube, *A*, and made to pass between the horizontal plate, *B*, and the surface of the liquid; the carbureted air then rises, as shown by the arrows, and enters the double valve, *C*, shown below in detail, by which it is mixed with an additional quantity of air, which enters by the orifice, *D*, at the top; the mixture then passes to the motor by means of the tube, *E*. The admixture of air is regulated by the handle on the left, and the supply of gas by that on the right. The float, *F*, serves to indicate the level of the gasoline in the carbureter by means of a rod which passes through the tube of admission; and the tube itself is arranged to slide up and down in order to maintain a constant difference between the horizontal plate and the surface of the liquid, this plate being attached to the lower end of the tube. In order to avoid the cooling of the gasoline by evaporation, it is warmed by means of the tube, *G*, through which passes a portion of the hot gas escaping from the motor. By this means a nearly constant temperature is obtained for a given speed of the motor.

The cylinder, *H*, of the motor is of cast steel, with projecting flanges which serve to increase its radiating surface and prevent overheating; above is the chamber, *J*, in which the explosion of the gas takes place; at the top of the chamber is the valve, *K*, which admits the gas coming from the carbureter; the valve is normally closed by means of the spring, *S*, whose pressure is regulated so as to allow the valve to open upon the descent of the piston. Opposite is the exhaust valve, *L*, which permits the waste gases to escape after the explosion; to the valve, *L*, is attached a rod which passes through the cover of the exhaust chamber and engages with a cam, *M*, which, by pushing up the rod, opens the valve at the proper instant, this valve being normally closed by the spring, *r*. At *W* is shown the igniter, consisting of two copper rods passing through an insulating bushing and so arranged as to allow a spark from the induction coil to pass in the interior of the chamber for the ignition of the gas. The piston, *O*, is a hollow steel casting provided with three packing-rings, and carrying the wrist-pin. The piston is connected with the inclosed fly-wheels, *Q* and *R*, and with the shafts, *S* and *T*, by means of the piston-rod, *P*. The shaft, *S*, carries a pinion which engages with another of twice its diameter, operating the small shaft above, *t*, which carries two cams; the cam to the right serves to open the exhaust valve once in every two revolutions, while that to the left acts upon the lever arm, *U*, carrying the contact, *V*, of the induction coil, by means of which a spark is caused to pass at *W*, thus igniting the gas contained in the chamber of the motor.*

This induction coil is operated by four dry piles. From the preceding description the action of the motor will be readily understood. When the piston descends, it produces a vacuum in the top chamber, by the action of which the valve, *K*, opens, admitting the detonating mixture from the carbureter; when the piston rises, it compresses this gas and the valve of admission closes. At the instant of the second descent of the piston the cam actuates the lever, making contact with the induction coil, upon which a spark passes, causing an explosion of the gas, which pushes the piston with sufficient force to cause it to pass twice through the same position; when the piston rises after its descent, it compresses the residual gases of explosion, and at this instant the cam, *M*, lifts the exhaust valve and the gas

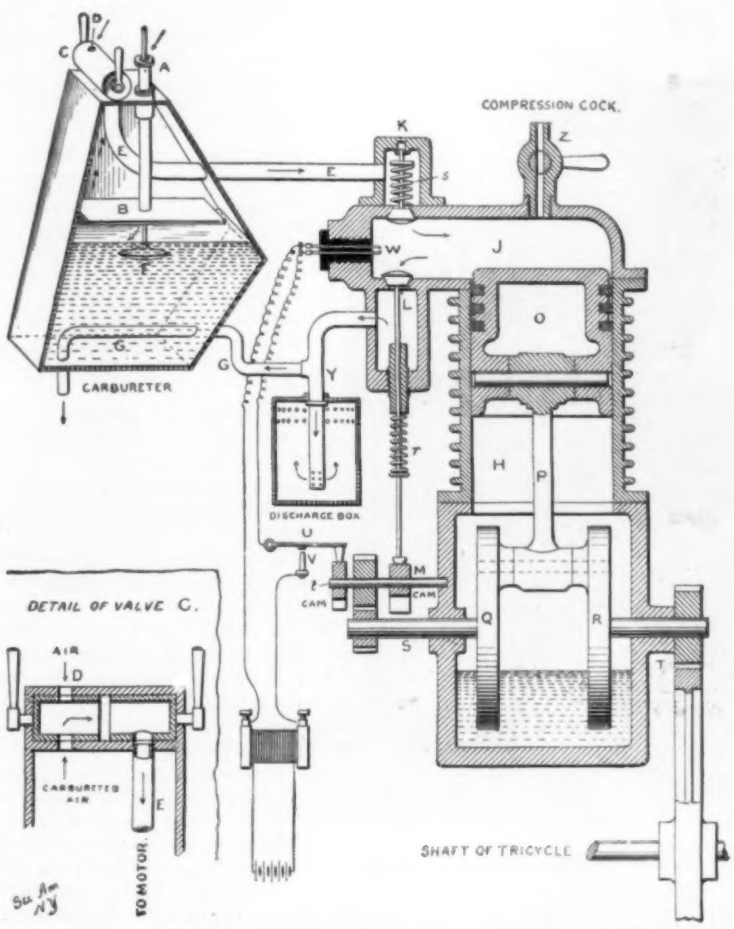
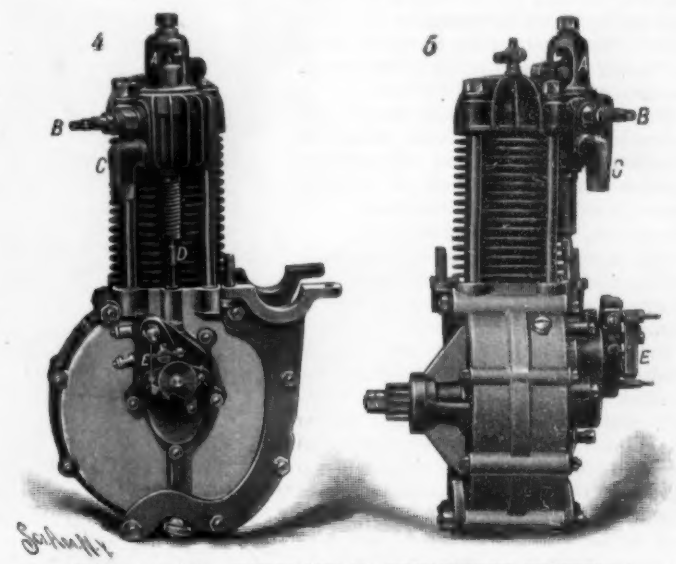


Fig. 1.—SECTION OF TRICYCLE MOTOR.



Figs. 4 and 5.—MOTOR FOR DE DION-BOUTON TRICYCLE.

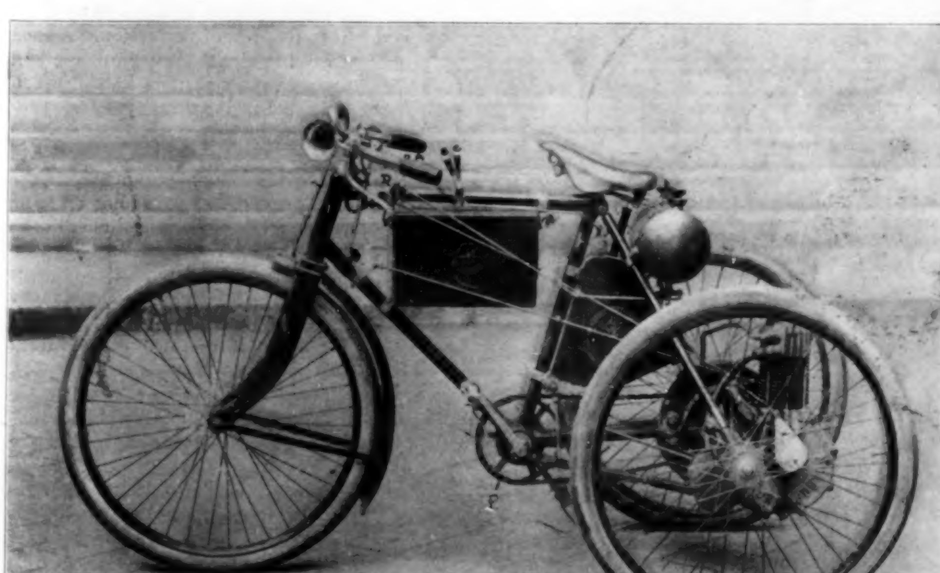


Fig. 2.—THE DE DION-BOUTON AUTOMOBILE TRICYCLE.

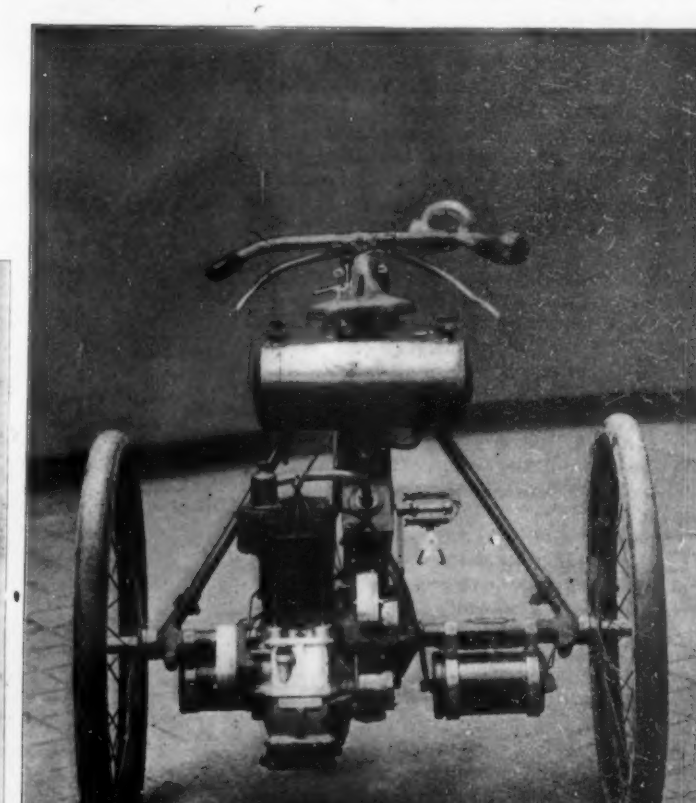


Fig. 3.—REAR VIEW OF TRICYCLE SHOWING MOTOR.

* Shaft, *T*, carries a pinion which engages with a gear wheel on the shaft of the tricycle.

leaves the motor by the exhaust pipe, Y. When the piston redescends, this valve closes and the upper valve opens, as before, to admit a fresh supply of gas and so on.

The action of the motor is thus determined by four different periods, which may be characterized as (1) introduction of gas, (2) compression, (3) explosion, (4) evacuation of the products of combustion.

Figs. 2 and 3 show the tricycle complete. In Fig. 2 the handle, *D*, serves to open or close at the proper time the cock shown in the diagram, Fig. 1, at *Z*, which permits the piston to ascend and descend freely when starting the motor. The handle, *A*, displaces the support of the contact of the induction coil in order to vary the instant of ignition with relation to the introduction of gas; the handles, *B* and *C*, serve respectively to regulate the admission of gas to the motor and the introduction of air into the carbureter. The pedal, *P*, operates the main axle of the tricycle and at the same time starts the motor, which is geared to the same axle. The tricycle may be operated by the pedal alone in case of accident or in mounting steep grades.

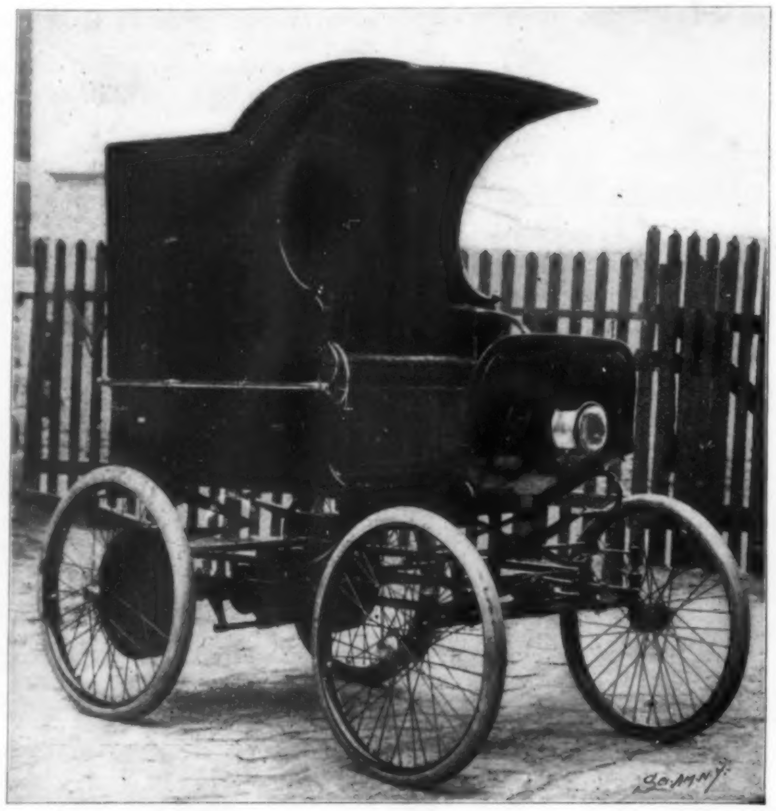
Figs. 4 and 5 show the motor dismounted and provided with a frame for securing it to the tricycle. *A* is the admission valve; *B*, igniter; *C*, exhaust pipe; *D*, rod and spring of exhaust valve; *E*, contact, cam, and binding-posts.

The maximum speed of the tricycle is 40 kilometers (24 miles) per hour, and grades of eight to ten per cent may be mounted without the aid of the pedals.

The Waltham Manufacturing Co., of Waltham, Mass., will exclusively sell the product of De Dion-Bouton & Co. in the United States, and in addition to selling the regular machines now manufactured by De Dion-Bouton & Co. they will import the De Dion motors and make a complete line of "Orient motor cycles and motor carriages." They are now building tricycles, trailers and attachments, tandems, and a light carriage, and will add other vehicles.

Paris. E. BERNARD.

A COMBINATION PLEASURE AUTOMOBILE DELIVERY VEHICLE.



INDIANA BICYCLE COMPANY'S CONVERTIBLE MOTOR DELIVERY WAGON

THE SAME VEHICLE, WITH THE TOP REMOVED, CONVERTED INTO A PLEASURE CARRIAGE.

Our engravings represent a unique form of vehicle which is made by the Indiana Bicycle Company, of Indianapolis, Ind., manufacturers of the "Waverley" bicycles. The peculiarity of this carriage is that the delivery body is separate from the body proper, so that it can be used for the delivery of parcels or as a pleasure vehicle. This style of vehicle is intended for the use of merchants when they desire to have a delivery wagon for use on week days and a pleasure vehicle on Sundays, and the change from business wagon to carriage is quickly made.

The carriage weighs 3,310 pounds and is operated by electricity, furnished by forty-two 80-accumulator cells. There is a specially designed multipolar motor of two and a half horse power which drives the vehicle. The shaft is geared directly to the rear wheel, propelling the vehicle by a single reduction. Each rear wheel revolves independently of the other through compensating gears which are placed in line with the motor shaft. It has five speeds, varying from three to twelve miles per hour, and the radius of action is, under favorable conditions, about forty miles; but on its trial trip, with the batteries as taken from the forming room, and not having a regular charge, the wagon made 54·6 miles, coming in strong at the end of the trip. The load was only two men. During this run it went through unimproved streets, over grades, some of which amounted to 7 per cent, and was put through as severe a trial as possible in a city like Indianapolis. The greater part of the run was made, however, on well paved streets, as it is likely that a vehicle of this kind would generally be used where the streets and roads are fairly good. The running gear is of tubular construction, and the wire wheels have ball bearings throughout and are fitted with Royal single tube pneumatic tires. The delivery body is separate from the body proper and is furnished with angle irons along the lower edges which engage slotted tubes attached to the body by brackets, and sufficiently raised to prevent contact, thereby protecting the finish. The slotted tubes are raised by their brackets sufficiently to carry the delivery box about ⅝ of an inch above the body proper. The wagon which we illustrate is now running about forty miles a day in Indianapolis and is considered to be a very successful vehicle. The same company are making a number of other styles of automobile carriages and vehicles, but the one we illustrate is of particular interest owing to its convertibility.

Value of Trade Marks in the Philippines.

According to a Consular Report which has just been issued, trade marks are worth a great deal in the Philippines. One representative firm of importers writes as follows:

"Well-known marks are worth a great deal in this country. Take, for instance, our mark 'cock in cage,' for white drill. The same quality, the same size, or even wider, imported by other houses is paid for at the rate of $8.50 a piece, which leaves a modest margin. We sell our brand at $10, and dispose of 50 to 60 cases a month in Manila and 20 cases in Iloilo."

In view of facts like these, American firms who are thinking of trading in the Philippines should obtain protection of a duly registered trade mark.

Wrappings for Bicycles.

Notwithstanding the rapid improvements which have been made in the construction of bicycles, the method of packing and covering them for wholesale delivery is still in a primitive condition. It is one of those details, apparently trivial, which get overlooked, says The Cycle Age and Trade Review, and the ancient method of swathing frames and wheels in yards and yards of intricate paper or fabric bandages is yet with us. The system teems with disadvantages and difficulties, the number of packers required, the space necessary for wrapping at the factory and unwrapping at the sellers' stores, and the untidiness of this operation, are all sufficient reasons against perpetuating the present methods.

A Birmingham inventor has recently devised a system of protecting the frame by means of tubes of stiff paper or cardboard slotted longitudinally, so that they may be slipped over the frame tubes and held in position both by their natural contraction and by tapes or other suitable additions. For all ordinary purposes the tubes, such as used for containing photographs, form ample protection for the frame; but the inventor also provides for the lining of these tubes with a soft material for additional protection and for attaching fabrics at the ends of the tubes to wrap over the lugs.

Specialism in Bicycle Construction.

The tendency toward specialism, which is a marked feature and one of the most important secrets of our success in the mechanical industries, is seen in a very high state of development in the manufacture of bicycles. In the earlier history of the wheel, when makers were few, and shapes and dimensions were necessarily experimental, it was customary for each firm to build its machines practically from the ground up. The manifest advantages in respect of economy resulting from specializing the work are responsible for the growth of several large establishments which are devoted entirely to the construction of some single part of the wheel. These firms are in the habit of buying up all the patents possible covering their particular form of construction, and an inquiry as to the number of patents thus controlled suggests what a large amount of inventive thought has been bestowed on the bicycle as a whole to bring it to its present perfection. A good case in point is the Fauber crank hanger, the manufacturers of which now control as many as seventy patents on this part of the wheel alone. Of course it will be understood that these patents cover the cranks, sprockets, and hanger combined; but even in this case the total number of patents is extraordinary, and suggestive of the searching scrutiny to which every item of the bicycle is being subjected in the endeavor to bring it to the highest mechanical efficiency.

Work at the Rock Island Arsenal.

The War Department is to develop at once the machinery plant at the Rock Island Arsenal to such an extent that it will turn out 2,500 Krag-Jorgensen rifles per day. There is no intention of curtailing the work on small arms now in progress in the Springfield Arsenal. The latter plant will still continue to supply the bulk of arms called for in times of peace, and the Rock Island Arsenal will be developed so as to have a vast reserve power in time of need. The ordnance officers state that the war last summer shows that private establishments cannot be depended upon to install equipment rapidly enough to meet emergencies. Congress has appropriated $500,000 for ordnance work. All of this sum is available for the Rock Island Arsenal. There are at present 1,500 men employed in the works, and last July they numbered 3,000.

The St. Louis Fair.

The subscriptions from various sources for the St. Louis fair have now amounted to $2,673,000, in addition to the $2,100,000 pledged by collecting committees. The amount so far actually raised is now close to the $5,000,000 originally promised.

LABORATORY TESTS OF THE BICYCLE.

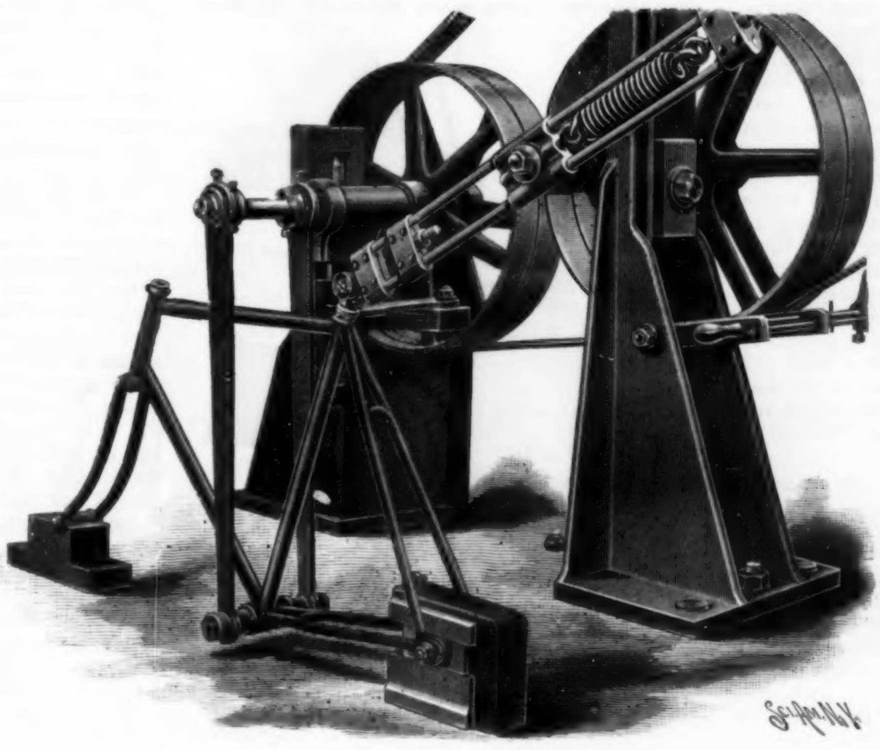
There is probably not a machine in the world that works on such a small margin of safety as the bicycle. It has been estimated that the safety "factor" is only about 1½ in the lightest machines, and while this is probably too low an estimate, it is certain that, when a powerful 200-pound rider is climbing a steep hill, or worse, coasting down a hill whose surface is rough and lumpy, the margin of safety must be a very narrow one—narrow, that is to say, compared with that allowed in other forms of mechanical construction. Thus the bridge builder provides sufficient steel in the various members to insure that the heaviest possible loads that can come upon them will not strain the metal above from 20 to 30 per cent of its elastic strength, and even in designing structures that are subject to quiet or static loads, the material is not strained beyond 33 per cent of its strength; that is to say, the parts are made not less than three times as strong as is necessary to bear the greatest stress that will be put upon them.

We cannot calculate the maximum stresses of a bicycle with the nicety with which they can be computed in engineering structures and in the heavier classes of machinery. The conditions of use and abuse are so various—the hard use of a powerful but cautious rider being less severe than the abuse of some reckless boy—that the only way in which the proper strength for a wheel can be determined is by trial, and by a careful selection and test of the materials of which it is constructed. If an engineer were told to work out the strain-sheet of a bicycle in the same way as he would that of a railway bridge, taking the possible maximum stresses due to the work of heavy and powerful riders upon rough and hilly roads, and proportioning his parts so that the metal should not be strained above 10,000 to 15,000 pounds to the square inch, the wheel built from such a strain-sheet would be as heavy as the primitive boneshaker of thirty years ago.

A comparison of the bicycle considered as a means of transportation with a railway car brings out the remarkable fact that it takes forty-six times as much dead weight of material to carry a man on the railway as it does on a wheel. For a modern coach carrying sixty people will weigh about 70,000 pounds, which is at the rate of 1,167 pounds to the passenger; while a modern bicycle will weigh only 25 pounds. If we take the Pullman car as an example, the disparity is yet more striking; for here we have only twenty-four passengers carried on a car weighing 100,000 pounds, or say 2 tons to the passenger. In this case the car weighs 167 times more per passenger than does the bicycle.

From these considerations it is evident that the light weight of the bicycle can only be maintained by the most careful inspection of materials and workmanship, and in the case of all the standard bicycles it is safe to say that this inspection is very carefully made. Every lot of stock is subject to tests in the testing department, which, by the way, is coming to be recognized as an indispensable part of all large American establishments in the engineering and kindred trades, and the finished parts and finished machines are in some cases put to special tests to determine their strength and running qualities.

We present an illustration of one of many testing machines installed in the laboratory of the Pope Manufacturing Company. It is used for trying the strength of the frame, and it is designed to reproduce as far as possible the actual stresses to which a frame is subjected when put to hard usage on the road. The principal stresses are those due to the weight of the rider applied at the top of the seat-post tube and the alternate transverse bending stress due to the pressure on the pedals. The frame is mounted upon two blocks, one under each hub as shown, the crank-hanger being left unsupported. The stresses due to the weight of the rider are reproduced by means of a short-throw crank driven by a pulley, and a spring connecting rod, as shown, one end of which is clamped to the seat-post, while the crank engages a sliding head which is attached by a powerful spiral spring to the other end. The rapid rotation of the crank thus imparts a series of cushioned blows whose effect on the frame is similar to that due to the speed of the machine, inequalities of the road, the pneumatic tires, and that part of the rider's weight which is on the saddle.



MACHINE FOR TESTING BICYCLE FRAMES.

The crank-shaft stresses are applied by means of two connecting rods, one on each side of the frame, which are driven by eccentrics set at 180° and carried on a second pulley-driven shaft. The stroke of the eccentrics is of course very short, merely sufficient to bring a heavy bending stress alternately on each side of the crank-hanger. One machine out of every lot is placed in this instrument of torture, and if, after it has been merrily thumped and wrenched for a stated length of time, its tubing is true, brazing sound, and the whole frame in line, it is considered that no fair usage on the road can ever break or distort it.

One must confess that, interesting as the various departments of a bicycle factory undoubtedly are, the most fascinating plant is to be found in the department of tests, for here we see the fruition of the labor of the whole establishment. That all-absorbing question as to the respective ease of running of a chain and a chainless wheel is here determined to absolute demonstration on an ingenious device known as a float dynamometer. The wheel is mounted at the side of a tank of water in which are two separate floating platforms. On the first platform is mounted an electric motor, on the other a friction brake. The motor is connected by a universal joint shaft with the axle of the bicycle, and the friction brake is similarly connected with the shaft of a pulley upon which the rear or driving wheel of the bicycle runs. It is evident that the power given out by the floating motor will be in part absorbed by the internal resistance of the bicycle, the rest being returned at the floating brake.

The tangential reaction of the motor will cause the float on which it is carried to tilt over; similarly, the pull of the brake will tilt the brake float. If, now, the tilting in each case be corrected by moving a sliding weight on a horizontal graduated arm, the readings of the two arms will show respectively the power given to the bicycle by the motor and the power returned to the brake from the bicycle. The difference will represent the loss by friction in the bicycle. If a chainless and a chain wheel be tested in the same apparatus, their respective efficiency can be determined with the greatest accuracy.

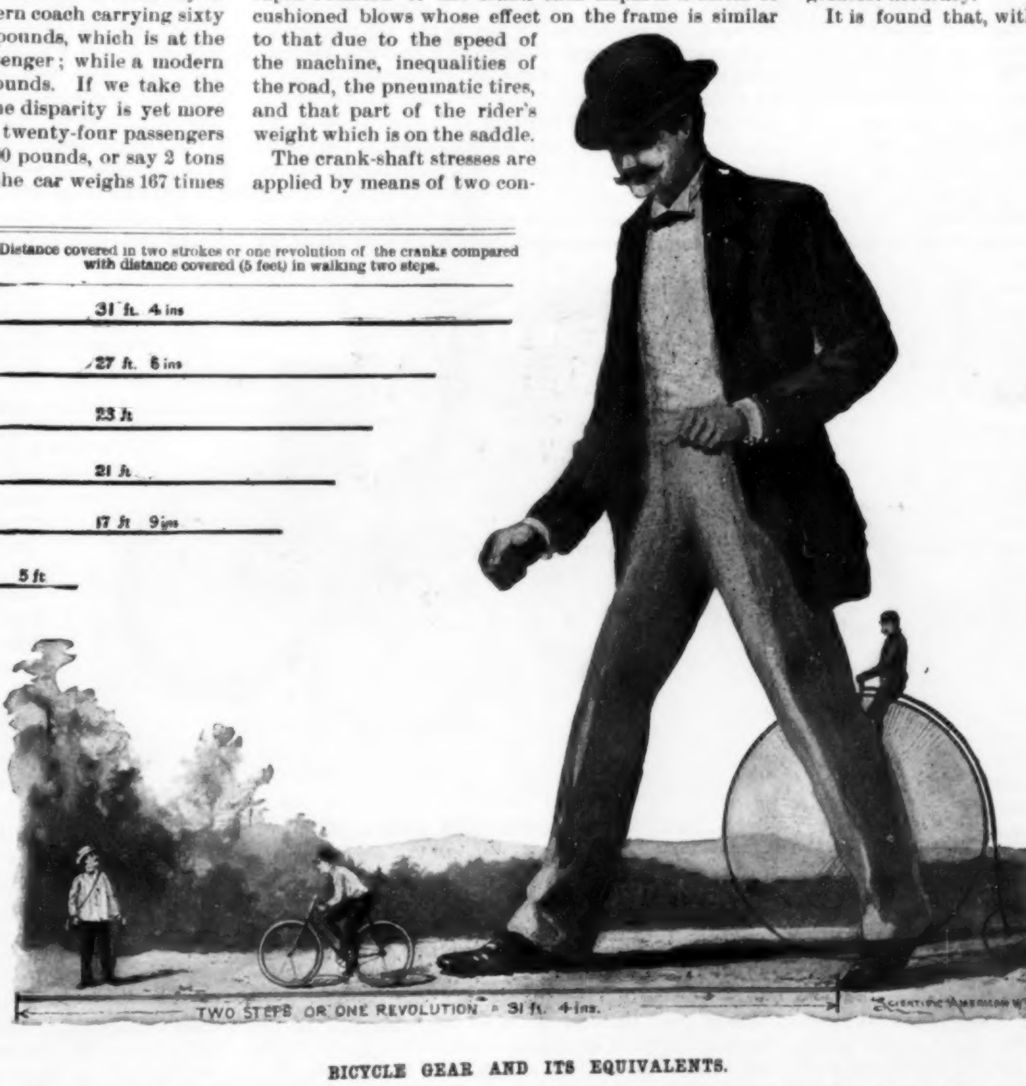
It is found that, with the gears new and perfectly clean under light loads, there is practically no difference in efficiency between the Columbia chain and chainless wheels, but, as the load is increased, the chainless wheel begins to show a gain which grows rapidly as the load is still further augmented—a result which shows the bevel gear to be superior to the chain gear for hill climbing, and superior to it in all cases where the chain has "stretched" or is fouled with grit or dust.

BICYCLE GEAR—WHAT IT IS AND WHAT IT DOES.

Those of our readers who were bicycle enthusiasts in the days of the old "ordinary" will remember that a wheel was designated by the diameter, in inches, of its driving wheel, which varied from 48 to 62 inches, according to the length of leg of the rider. Thus we were wont to speak of the respective merits of our 50-inch Rudge, or 54-inch Victor, or 60-inch Columbia, as the case might be. The diameter of the driving wheel was the most variable element, and hence it was chosen as the designating feature.

With the introduction of the rear-driven safety it was no longer possible to grade the wheels according to the diameter of the

Size of gear.	Gear used for	Distance covered in two strokes or one revolution of the cranks compared with distance covered (5 feet) in walking two steps.
120	Paced racing.......... ...	31 ft. 4 ins
105	High gear for road riding ...	27 ft. 6 ins
88	Sprint racing.........	23 ft
80	Ordinary gear for road riding.	21 ft
68	Lady's wheel	17 ft 9 ins
Two steps	Walking	5 ft



BICYCLE GEAR AND ITS EQUIVALENTS.

A safety geared to 120, in one revolution of the crank, covers the same distance as that covered by one revolution of an ordinary wheel ten feet high, or two strides of a man thirty-five feet high.

driving wheel, for the reason that the latter all settled down to a common size of 28 inches; but as the introduction of the chain drive enabled the speed of revolution of the driving wheel to be increased over that of the cranks, thereby increasing its circumferential speed, it was decided to designate the bicycle by the effective diameter of the rear wheel as thus secured. The increased circumferential speed of the wheel is obtained by placing a larger sprocket on the crank axle than on the rear wheel; for the rear sprocket (with its wheel) will run just as much faster as the front sprocket is larger than itself. Thus, if there are 24 teeth in the front sprocket and 8 in the rear, it is evident that, by the time the 24 teeth of the front sprocket have engaged and drawn forward the chain, the chain will have engaged and drawn forward 24 teeth on the rear sprocket, and to do this it must have rotated the 8-tooth rear sprocket three times. Now, this will cause the 28-inch rear wheel to travel over a distance equal to three times its own circumference, or equal to the single circumference of a wheel three times as large as itself, or 84 inches in diameter. Since this effective diameter is due to the chain and sprockets, it is spoken of as "gear," and a bicycle with an effective driving wheel diameter of 84 inches is known as an 84-gear wheel.

It is evident, then, that since the diameter of the rear wheel is constant, the gear depends solely upon the relative size of the sprockets employed, and is found by the simple formula, $G = \frac{D \times F}{R}$, where G = the gear; D the diameter (28 inches) of the rear wheel; F the number of teeth in front sprocket and R the number of teeth in rear sprocket. Thus 84 gear can be obtained by a 21-tooth front and a 7-tooth rear or a 30-tooth front and 10 tooth rear. The gear of a bicycle, then, is the diameter of a circle whose circumferential length is equal to the distance traveled by that bicycle in one revolution of the cranks.

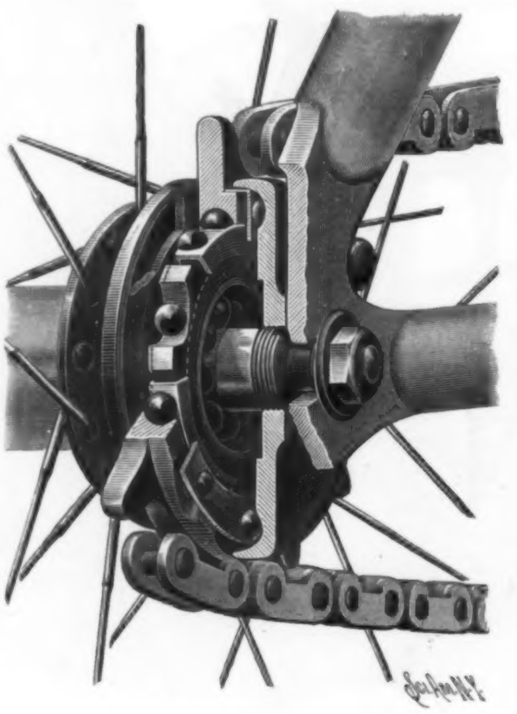
It is largely the possibilities of "gear" that make the safety so incomparably superior to the ordinary bicycle. Formerly one was restricted to what he could stretch, and only a tall man could negotiate a 60-inch wheel. Now a child's wheel is geared to 60, and many women are riding wheels of 76 to 84 gear. Gears of 96 to 105 are not infrequently met with on the road, and there is one famous rider in paced races who has won his reputation on a wheel geared to 120 inches. It is the great distance covered in proportion to the speed of pedaling that constitutes the charm of the high gear, at least as far as the imagination is concerned; for that frailty of human nature which expresses itself in a desire to get "something for nothing" will not down, and asserts itself in all kinds of places and at unexpected times. In riding a high gear there is a sense of getting out of the machine something more than we put in—even though mechanical orthodoxy tells us this cannot be—and there is no denying that, under favorable conditions of grade and wind, a day's journey can be made with less fatigue on a high than a low gear.

Of course, we all know that the total work done by a rider in propelling the same wheel over the same stretch of road, under identical conditions, never varies, whatever may be the gear employed. If I ride a 25-pound wheel a mile on the turnpike with a gear of 60, I do a certain amount of work; and if I ride the same wheel over the same mile in the same time with 120 gear, I do the same amount of work. In the latter case I turn my cranks more slowly, but I have to exert just as much more pressure upon them as their speed of rotation has decreased. If, with a view to reducing the pressure, I double the length of the cranks, then my feet must travel twice as far in a circle twice as large. Since work at the cranks may be regarded as pressure multiplied by distance, the total amount of work I do will be the same, whether I exert heavy pressure on short cranks moving in a small circle or light pressure on long cranks moving in a large circle.

Since in riding the same distance at the same speed, on the same wheel, the total work is the same, whatever the gear and whatever the length of the cranks, the question arises, What is the best gear to use? The answer is that, The gear must be determined by the physical and temperamental make-up of each individual rider. If we were to pick out a dozen men, and start them out to walk a hundred yards, we would find that no two of them took the same length of step. Some would fall into a long swinging stride of 36 to 40 inches, while others would trot along with little mincing steps of 18 to 24 inches. The speed might be the same, but the length of stride would be that which each individual had unconsciously found to be agreeable to his own idiosyncrasies of physique and temperament.

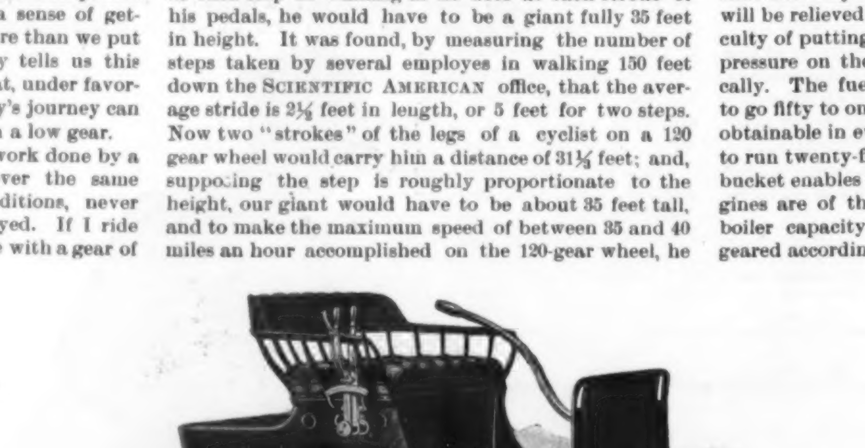
So with the question of gear and crank length. Some riders will get the best results with high gear and long cranks, others with low gear and short cranks, while a rider of the writer's acquaintance uses on the road a 104 gear with a 6½ crank, and will ride all day without any apparent distress. As a rule, tall men should use high gears and long cranks, a 6-foot rider being able to negotiate a 7½-inch crank with as little bending of the knee (a fruitful source of weariness) as a 5½-foot rider using a 6½ crank.

Our artist has shown in the accompanying sketch



THE TREBERT COASTER AND BRAKE.

how the gear increases the effective diameter of the driving wheel, raising it from 28 inches to as much as 120 inches in the case of one rider already mentioned. As a matter of fact, our fastest racing men are using a wheel from 2 to 3 feet larger than the largest locomotive driving wheels used in this country. Another interesting point brought out in the sketch is that the modern bicycle has increased the locomotive powers of man to such an extent that to cover as much ground at each step in walking as he does at each stroke of his pedals, he would have to be a giant fully 35 feet in height. It was found, by measuring the number of steps taken by several employes in walking 150 feet down the Scientific American office, that the average stride is 2½ feet in length, or 5 feet for two steps. Now two "strokes" of the legs of a cyclist on a 120 gear wheel would carry him a distance of 31½ feet; and, supposing the step is roughly proportionate to the height, our giant would have to be about 35 feet tall, and to make the maximum speed of between 35 and 40 miles an hour accomplished on the 120-gear wheel, he would have to step as frequently as a person of ordinary stature walking at a brisk rate.



THE VICTOR AUTOMOBILE CARRIAGE.

A French firm has undertaken the manufacture of a new metallic curtain for the Opera House at Besançon. The curtain is to be lowered after each act or in case of great danger. It is 60 feet wide and 54 feet high and is to be composed of aluminum sheets 13 feet long and 29 inches wide and $\frac{1}{32}$ of an inch thick. The total weight will be 4,000 pounds. If such a curtain were made of sheet iron, it would weigh 11,000 pounds.

THE TREBERT COASTER AND BRAKE.

Since the introduction of the automatic coaster and brake, improvements in construction have constantly been made which have increased the efficiency of the device to such an extent that the old plunger brake is beginning to disappear. Among the latest types of these brakes is the Trebert brake, made by the Trebert Automatic Coaster and Brake Co., of Syracuse, N. Y.

The brake in question comprises essentially a friction-disk secured to the hub of the rear wheel, a clutch on the disk, and a clutch on the rear sprocket-wheel. The two clutches are provided with inclined surfaces upon which balls, held in place by retaining rings, roll. The balls on the disk-clutch serve to lock the sprocket and clutch together when the wheel is in motion; and the balls on the sprocket clutch serve to bind the sprocket against the friction-disk in order to stop the wheel.

When the chain of the bicycle is pulling forward, the balls on the disk-clutch will also move forward and ride up their inclines, thereby locking the clutch and sprocket together so that both rotate with the wheel. When the rider desires to coast, he applies a slight back pressure to the pedals, thus causing the balls on the disk-clutch to roll down their inclines in order to release the sprocket from the clutch and to permit the wheel to rotate independently. When the rider wishes to stop, he applies a further back-pressure to the pedals, thereby causing the balls on the sprocket clutch to ride up their inclines and to bind the sprocket and friction disk so tightly together that the wheel is prevented from turning.

The brake, besides giving the rider full command of his wheel and enabling him to hold his feet stationary upon the pedals for the purpose of coasting, possesses the additional advantage of being readily applied to any wheel without the necessity of remodeling or changing the frame.

THE VICTOR AUTOMOBILE.

While we are considering hydrocarbon and electric vehicles, it must not be forgotten that there are also on the market excellent motor carriages driven by steam, and we take pleasure in presenting an engraving of the "Victor automobile," which is a steam wagon entirely automatic in its regulation, made by the Overman Wheel Co., Chicopee Falls, Mass. When the word steam is used it naturally brings to mind a certain uneasiness, but users of the Victor automobile need have no anxiety, for the boilers are tested and insured by the Hartford Steam Boiler Insurance Company, each boiler being tested by the expert of this well known company and a certificate given as to the test. The boiler is truly automatic, the water being fed into the boiler automatically with absolute precision. Thus the user will be relieved from the point which is the chief difficulty of putting steam in the hands of laymen. The pressure on the fuel tank is also regulated automatically. The fuel tank holds enough common gasoline to go fifty to one hundred miles, and gasoline is readily obtainable in every village. It also holds water enough to run twenty-five miles, and a collapsible soft rubber bucket enables one to get water at any place. The engines are of three and one-half horse power and the boiler capacity is five horse power. The machine is geared according to the roads and hills, and it is capable of running from a speed which is slower than one would walk to its maximum speed, which would ordinarily be about twenty miles an hour.

Infection by Speaking Tubes.

The speaking tube is an excellent means of infection, and The London Lancet has recently issued a note of warning concerning them. These tubes are practically unventilated except when in use, and when the person using them speaks, the moisture in the air which he exhales condenses on the sides of the tube, so that the products of respiration remain for the benefit of the next persons using the tube; and it is little wonder that the telephone is recommended in preference to the speaking tube by sanitarians. It is quite possible for tuberculosis or other diseases to be spread by speaking tubes; for it is necessary for the person in calling to place his lips in actual contact with the mouthpiece at the near end to make the whistle sound at the far end.

Tunnels under the Thames at London are multiplying rapidly. Hardly has the Blackwall tunnel been open when another at Rotherhithe is projected. It is to be 30 feet in diameter—3 feet more than the Blackwall tunnel. It is to be a mile and a quarter long. The total work will cost about $7,000,000, but nearly $4,000,000 of this will go for the approaches.

The Cyclist without a....

ACTUAL SIZE.

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Cyclometer is almost as much "at sea" as the ship without a log. It gives accurate information of distance traveled that is always useful and often of vital importance; besides the constant satisfaction that every rider finds in reading the exact record of his cycling achievements.

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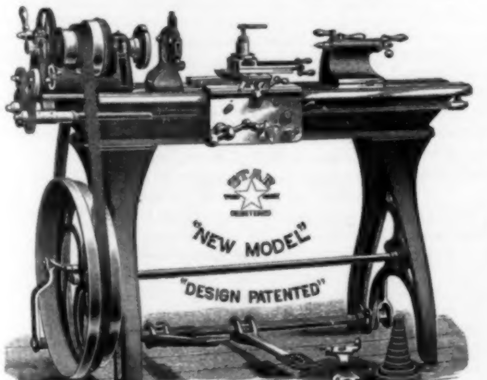

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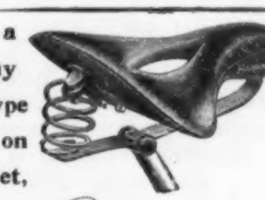

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AN AMPHIBIOUS TRICYCLE.

The "Amphibie" is the name M. Theodorides has christened his new nautico-terrestrial tricycle, which we illustrate herewith, and which has recently been tried in France.

The tricycle is constructed entirely of aluminum, with the exception of the chain and certain other parts which require the use of steel. The wheels have enormous inflated rubber tires, which give them a diameter of 3·83 feet, and which make each wheel a water-tight float, buoying up the machine on the water.

The tricycle can be used indiscriminately on land or water, and although it does not run very rapidly, it may be of considerable use in special cases.

It weighs but 66 pounds and sinks, when fully loaded, to a depth of only 12¾ inches. Our engraving shows very well the appearance of this curious machine while navigating on the water.

AN AMPHIBIOUS TRICYCLE.

Cheap Cab Service in New York.

The General Carriage Company, of New York, is to be incorporated for the purpose of constructing and maintaining hacks or other vehicles for hire on the public roads, streets, or highways of cities of the first class, which, of course, means New York and Buffalo. The corporation has the right to establish the time service and the distance service, and to subdivide the latter into a mileage and circuit service. It can charge rates of fare not exceeding 75 cents an hour for each person in the time service, and not to exceed 25 cents per mile for each person for the mileage service, and not to exceed 25 cents a person on the circuit service. It is proposed to establish cheap cab service such as now exists in London and Paris. There is a great field for cheap cabs in New York city, and the electric vehicles which have been in operation there for a long time have won a deserved popularity.

AT the sale of the Morrison cameos in London, a Greek gold ring from Tarsus with an intaglio of Bacchus was sold for $1,150. Another ring with the figure of Bacchus brought $925. The signet of Asander, King of the Bosphorus, from Kertch, brought $2,300.

Lord Charles Beresford and Automobile Cabs.

Lord Charles Beresford in his recent trip to America pointed out how much Great Britain is behind the times in the use of electricity. He was amazed to see how much work was done by electricity on board American warships where the English use steam. He is a warm advocate of automobile cabs. He attributed the congestion of London streets to the use of horses. He said, "While I was in New York I was supplied with a motor car which had the appearance of a cab and the manners of a kangaroo, but it always got me safely to my destination."

The Building Edition for May.

The Building Edition for May is a beautiful number and its contents are more than usually diversified. A residence at Newark, N. J., forms the subject of the colored cover. It is a handsome brick colonial house built by Messrs. McKim, Mead & White. There are also a number of fine interior views of this house. The stable for the same residence represents a unique treatment of a problem which is often neglected. There are a number of other interesting houses illustrated. The literary contents are fully up to the usual standard, the editorials being "An Architectural Symposium," "Equestrian Statues," "What to Do With Our Backyards," and "Architectural Education in the United States." There is also an excellent example of an old colonial doorway, reproduced from a measured drawing, and also an interior view of the Cathedral of Münster and the plan of the Palace at Düsseldorf.

The Current Supplement.

The current SUPPLEMENT, No. 1219, has many articles of great interest. The University of Pennsylvania Lecture Course is represented by the second part of Dr. Herman V. Ames' "Peculiar Laws and Customs in the American Colonies," which is concluded. "Wireless Telegraphy" is represented by an article which describes the Ducretet system. The usual notes and consular matter is published. "The Alkali Soils of the Yellowstone Valley" describes some very interesting investigations which have been carried on by the United States Department of Agriculture, in the interests of the inhabitants of this valley. "Electric Traction and its Application to Suburban and Metropolitan Railways," by Philip Dawson, is an important and exhaustive paper on the subject. "The Intelligence of Tropical Ants" is a most attractive paper by Dr. Eugene Murray-Aaron.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HARROW.—WILLIAM M. BAKER, Fortville, Ind. This harrow employs a series of revolving teeth in connection with rollers, the teeth being so mounted that, should one of them be broken, another may be readily substituted therefor. The depth to which the teeth may enter the ground may be regulated by plain rollers which are carried by hanger-arms. The adjustment of the hanger-arms regulates the depth to which the teeth enter the soil.

Bicycle-Appliances.

BICYCLE-SUPPORT.—BURR HUBBELL, Kelly's Corners, N. Y. The support has a column on which a body portion is mounted, provided with laterally-projecting lugs. A jaw is pivoted on the body-portion between the lugs, and, when drawn toward the body-portion, clamps the frame of the bicycle. A fork is attached to the body portion and engages the front wheel of the bicycle; and an arm held by the body portion engages the saddle-post tube.

SADDLE.—FREDERICK C. AVERY, 6104 Butler Street, Chicago, Ill. The object of this invention is to provide a saddle in which the seat will sustain all the weight and the horn no part of the weight. The horn is supported by an independent spring, and is made separate from the seat portion. The pommel-spring is attached to the middle plate adjustably; and the same bolt which secures the rear end of the pommel-spring also secures the front end of the seat-support connection. The saddle-cover not only covers the seat and extends forward to form the horn, but also lies over the sides of the saddle. If it be so desired, removable pads can be used between the seat portion and seat cover.

Electrical Apparatus.

TELEPHONE-TRANSMITTER.—EDWARD H. JOHNSON, Omaha, Neb. The transmitter devised by this inventor is designed to multiply the sound-impulses against the diaphragm so that they may be increased in the receiver. The transmitter comprises a diaphragm against which a ring of resilient material, a series of contacts on the ring, and another series of contacts with which the first-named contacts engage. The vibrations of the diaphragm will set the several rings in equal vibration; and the impulses will be greatly multiplied through the contacts.

Engineering-Improvements.

VALVE-OPERATING GEAR.—AUSTIN H. KRAUSS, Wymore, Neb. Upon the engine-shaft a hub is secured having flanges, one of which is provided with a slot, extending diametrically. To the other two flanges a plate is fastened, which is provided with a slot controlling the position of the eccentric. The principal feature of the invention lies in the form of this slot, which is neither straight nor the arc of a circle. The slot is divided into three parts, the central one of which is straight and the end portions curved. By means of this slot the eccentric may be adjusted to give the valve the desired lead for any amount of travel.

Mechanical Devices.

FOLDING AND CREASING MACHINE.—JOHN F. and JAMES A. CAMERON, Brooklyn, New York city. This invention provides a machine for folding, creasing, and cutting cloth into handkerchiefs before or after stitching. The machine is designed to take a bolt of cloth and to turn both edges over simultaneously, so as to form the folds necessary for stretching the edges, and to cut one edge so that it may be torn into designated lengths. The machine comprises folding-guides adapted to engage and fold the side edges of the handkerchief stock. A supporting-plate, which is cut away between the guides, permits the center of the stock to drop between them. Rollers engage and compress the folded edges of the stock.

CRANE.—ALEXANDER GRAFTON, Bedford, England. This crane is provided with a so-called "derrick-motion," for varying the radius of the crane by varying the vertical angle of the jib. The improvement devised by the inventor consists in a means for indicating the radius and the load which may be safely carried at that radius. The means consist in the combination of the jib-adjusting gear with a dial and index, one of which is carried by a rotatable axis in gear with the chain-barrel or pulley, so as to be revolved thereby, the gearing being so proportioned that the rotary part will make less than one revolution for the maximum number of revolutions of the barrel or pulley required for adjusting the jib between the extreme limits employed in practice.

Railway-Contrivances.

BOLSTER FOR LOGGING-CAR FRAMES.—SURRY PARKER, Pinetown, N. C. The bolster is provided with a standard movable on the bolster, extending above the surface thereof when in use, and below the top surface and out of way when loading or unloading. A retaining device holds the standard on the bolster, guides it in its up-and-down movement, and limits the sliding movement. The standards always remain on the bolsters, and can be readily lifted into an extended position and locked to retain the logs, or released to permit the lowering of the standards for loading or unloading the logs.

Miscellaneous Inventions.

ACETYLENE GAS GENERATOR.—JOHN CARLSON, Mandan, N. D. In this machine an ordinary bell-gasometer floating in a water-tank is used in connection with a generator. A valve-controlled pipe connects the water-tank with the generator, the valve being held normally closed by a lever. An arm is pivoted upon the bell and is adapted to engage the lever to open the valve when the bell descends, in order to permit more water to reach the carbid, and thus generate a new supply of gas.

DISPLAY-RACK.—JOHN B. CROWDER, Talucah, Ala. This improved display-rack is especially intended for holding nails, brooms and tinware, and is provided with an upright or post having upper and lower rings. Nail-boxes furnished with broom-holders, are seated at their lower ends on the lower ring and have hooks engaging the upper ring. On the post, above the upper ring, a tin-holding frame is mounted.

APPARATUS FOR SEPARATING AND RECOVERING VALUABLE VAPORS.—JAMES R. WHITING, Stamford, Conn., and WILLIAM A. LAWRENCE, Waterville, N. Y. In the separation of air from the hydrocarbons known as the "lighter products of petroleum," while they are in a vaporous state, valuable products are lost by mixture with air. The inventor of the present process prevents this loss by employing a series of cooling-tanks and vapor-collectors by means of which the loss of the volatile products is prevented. These products, it is said, are recovered not only without detriment to the previous operation of evaporation and condensation, but assistance is rendered to the previous operations by removing from them all back pressure of this vapor.

CLOTHES-PIN.—MELVIN E. THOMSON, Clermont, Penn. By means of the clothes-pin devised by this inventor, it is possible to secure the clothes without fastening them directly upon the line. A wire structure is employed having at its top a hook, and at its bottom clamping devices by which to engage and removably hold the clothes.

WATER-FILTER.—SAMUEL M. SUMAN, Riverside, Cal. The water filter comprises a series of filter-beds, each having an inlet at the bottom and an overflow at the top. Between adjacent filter-beds, charcoal-receptacles are arranged to receive the water from one filter-bed and to deliver it to the inlet of the next following filter-bed, each charcoal-receptacle being provided with a top portion over which the water flows. The filter is designed to be used in dwellings, hotels, soldiers' barracks, and miners' camps.

FIREPROOF STRUCTURE.—GEORGE SPRICKERHOFF, Manhattan, New York city. The present invention provides a fireproof structure such as a floor or ceiling, which structure is light, yet strong. The structure consists of beams to which stirrups are attached. Supporting-strips are sustained by opposite stirrups; and tie-rods are extended through openings in the strips. To the tie-rods a netting is secured which forms a support for a fireproof cement or concrete, filling the space between the netting and the top of the beams. The structure, besides being strong and light, has the merit of being readily put in place.

SUSPENDER-BUCKLE.—MAX RUBIN, Manhattan, New York city. The buckle comprises two U-shaped sections pivoted together to form a loop, the other ends of the sections overlapping each other. Each of these ends is formed with a jaw. A spring engages the sections to hold the jaws in clamping position. The jaws hold the suspender-tips and are capable of being separated by a pressure upon the body of the buckle, and of being automatically restored to locking position by the spring.

WIND-WHEEL.—OREN RUBARTS, Newport, Ore. This wind-wheel is provided with a turn-table from which arms extend in opposite directions. A vane is mounted on one of the arms, and a shaft is mounted in bearings on the other of the arms. To the outer end of the shaft a hub is fixed, on which blades move axially. On the shaft a governor-disk connected with the blades is mounted to slide. A governor-rod has connection with the disk and is mounted to slide on the arm supporting the shaft. On the turn-table a pulley is supported, over which a chain extends, connecting with the rod forward of the pulley. Another chain extends over the pulley and connects with the rod rearward of the pulley. A balancing weight is adapted for connection with either of the chains. By increasing or decreasing the weight, the speed or power transmitted can be increased or decreased.

CLARINET.—GUSTAV L. PENZEL and EDWARD MÜLLER, Manhattan, New York city. The G-sharp key in this clarinet consists of a pivoted finger-piece formed with a rearward extension and a key proper having a connection with the finger-piece whereby it will open when the finger-piece is depressed, but will move independently of the finger-piece when the latter is depressed. A trilling-lever actuated from the key F-sharp is arranged to engage with the key G-sharp proper in order to trill that key when the finger-piece is depressed. Keys B-natural and C-sharp provided with finger-pieces, lie over the rearward extension of the finger-piece of the key G-sharp, whereby the key G-sharp may be trilled when either of the B-natural or C-sharp finger-pieces is depressed.

BREAST-SHIELD.—EBENEZER MURRAY, Deadwood, S. D. The breast-shield comprises two cup-shaped breast-covers having diametrically opposite, horizontal tabs in line with their centers. A cap is hinged to each cover at the side of the aperture. A body-strap connects the outer tabs; and shoulder-straps connect the body-band with the breast-covers.

FURNACE-ATTACHMENT.—GEORGE M. LINDSAY and GEORGE SAUNDERS, Andover, Mass. The object of this invention is to provide a simple attachment by the use of which all cold air will be drawn from the hot air flue by the furnace-draft, the same draft serving to force the hot air through the flue, thus distributing the hot air uniformly. Connected with the hot air flue leading upwardly from the furnace, is a tube communicating with the interior of the flue on the lower side of a horizontally-disposed portion of the flue, and also with the furnace near the bottom.

VEHICLE-WHEEL.—WILLIAM W. KITCHEN, Rochester, N. Y. The wheel devised by this inventor com-

(Continued on page 315.)

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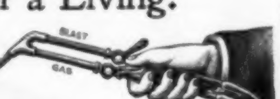

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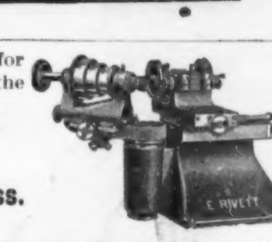

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Treats of all the many Amateur Sports and Pastimes, and at this time of the year of Golf and Fishing in particular. The following articles are in the May number:

Golfing 'Round the Hub, by George H. Sargent, in which something of each of the twenty-nine links within a radius of twelve miles of Boston's City Hall is told.

The Challenge of the Shamrock, by Capt. A. J. Kenealy.

About Fly Casting, by Geo. E. Goodwin.

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Golfing 'Round About the Quaker City, by Hanson Hiss, will be published in June **OUTING,** which will also contain:

Through the Green with the Iron Clubs, by Findlay Douglas (amateur champion of the W. S.) An article of value to every man and woman who knows a niblick from a mashie.

Also,

Where the Ouananiche are Waiting, by Ed. W. Sandys, which tells of fine fishing and hunting to be had in the wilderness north of Quebec.

The June issue will be published May 25th.

JULY OUTING will contain:

'Round and About Chicago with the Golfers, by Alexis J. Coleman, besides several fishing articles and golf records now in the hands of the illustrators.

The Golf of Gotham, by Charles Turner, is now being prepared for the August issue.

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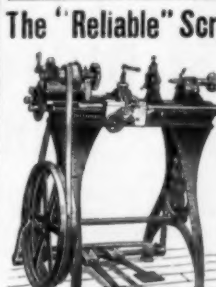

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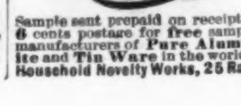

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prises an inner rim supported by a hub, and band-springs interposed between the two rims. The springs are secured to one another and to one rim, and have their ends adjustably secured together and to the other rim. The inventor claims that a wheel thus constructed possesses all the buoyancy of a pneumatic-tired wheel, and that it has the advantage of being much stronger and of being more easily repaired.

PROCESS OF TANNING.—GEORGE W. HOUSTON, Marietta, Fla. Instead of using red-oak bark or any of the other tanning agents, the inventor of this new process employs an ooze made from a shrub commonly known as "horse-wickey" or "stagger-bush." This ooze, it is stated, will not only tan leather more quickly than other materials in common use, but is also much more plentiful and economic, and produces a fine grade of leather at less expense. According to the strength of the ooze and the character of the hides, the tanned leather can be given various shades.

WINDING-FRAME.—CORRY JONES, Long Island City, N. Y. This invention provides improvements in silk-winding frames in which quills are held by cones and in which the spindles are removably connected with the driving mechanism. The improvements in question provide means whereby the quill and the filling disconnect automatically the spindle from the rotating well to permit a convenient removal of the quill and spindle from the machine without danger of entangling the silk. The improvements also permit the substitution of an empty quill for the quill-spindle, and the automatic connection of the spindle with the driving mechanism.

PROCESS OF MANUFACTURING MINERAL WOOL.—ALEXANDER D. ELBERS, Hoboken, N. J. It is the purpose of the present process to provide a means for making mineral wool which is more free from sulfur and therefore of a better quality than can be produced by the methods at present in use. The process consists in remelting hardened blast-furnace slag in a cupola-furnace in admixture with the sulfates of alkaline earths and blowing it into mineral wool.

BLACKING-BRUSH.—JOSEPH R. DE WITT, San Antonio, Tex. Upon the back of a blacking-brush a wheel is mounted connected by arms with a dauber and with a box of blacking, the wheel being operated by a rod. In its normal position the box is held in place by a catch. When it is desired to replenish the dauber's supply of blacking, the rod is pushed forward, thus causing the wheel to carry the box over the bristles of the dauber. When a sufficient amount of blacking has been gathered by the dauber, the rod is pulled back, thus causing the box to be returned to its normal position.

LINE-PEN.—LYMAN H. ZEIGLER, Millbank, S. D. The pen provided by this inventor is designed to facilitate rapid adjustment, thus enabling lines of varying width to be conveniently and effectively drawn. The pen has two pivotally connected arms pressed apart by a spring. Two fingers are attached to the arms and coact with each other to form the pen, the spring serving to keep the fingers together. A thin plate is held between the fingers and has its free portion twisted to spread the ink.

ORE-LEACHING APPARATUS.—ALBERT F. DUEY, Salida, Colo. The apparatus includes a leaching-tank, in the bottom of which is a perforated pipe connected with a compressed air supply. The tank containing the leaching liquid is connected with the air-supply pipe, whereby the air and liquid are injected together. The stirring of the ore by the bubbles of air serves to increase the efficiency of the solvent liquid, so that the mineral is more quickly dissolved than would otherwise be possible. The apparatus can be used in chlorination and in the cyanid or other chemical processes of treating ores, performing its work, it is claimed, from one to thirty-six hours more quickly than has hitherto been the case.

ORGAN-ACTION.—JOSEPH SLAWIK, Bloomfield, N. J. The invention provides an organ-action whereby the playing either of the upper or lower key-board causes a sounding of its sounding devices, and by the use of the desired couplings the playing of one of the keyboards causes a sounding of both sets of sounding devices simultaneously to produce a grand-organ effect. A pneumatic coupler-action is provided comprising an exhaust-valve over an outlet in the passage between the upper keyboard-valve and its action. On the valve-stem are a series of diaphragms over which air-chambers are located. By means of coupler draw-stops the air is exhausted from the chambers. By means of connections with the diaphragms from the valves of the lower keyboard the exhaust-valve is actuated on playing the keys of the lower keyboard.

HEEL-RUBBER.—JOHN H. MORROW, Chicago, Ill. The heel-rubber is designed to prevent the slipping of the foot on frozen or wet sidewalks, and is provided with a bottom which is made in the shape of the bottom for the heel of a shoe or boot, and which has a flange fitting the sides and back of the heel. The heel-rubber is furthermore provided with a jointed front flange which can be secured on the front portion of the heel.

WRENCH.—JAMES L. MARTIN, Marion Center, Penn. This nut-wrench has its jaws in the form of two spring-prongs adjusted toward and from each other by a screw, and adapted especially for application to a bit-brace. In wrenches of this class the spring-tongs frequently twist, and by being forced too closely together, are prematurely broken. In order to overcome this objection, the inventor provides the jaws with lugs, to one of which the adjusting-screw is rigidly secured. By means of this construction the true movement of the prongs toward and from each other is assured, and their springing out of alinement prevented.

SMOKER'S TRAY.—PERCY S. COOK, Manhattan, New York city. This invention provides a tray so constructed that ashes deposited at the margin will be directed to a well extending from end to end and from side to side of the tray. The invention also provides a match-receptacle adapted to receive loose matches or a pedestal capable of holding boxes of matches of different sizes in an upright position.

SMELTING-FURNACE.—CHARLES BISHOP, Knoxville, Cal. This furnace provides for a concentration of the heat above the arch upon which the ore is to be placed for smelting. In the central chamber a settling-pot provided with bullion and slag off-takes is located. An apertured ore-supporting arch is mounted above the settling-pot; and into this arch the fire-boxes open. Apertured flues in opposing sides of the central chamber lead through the sides of the arch; and apertured flues in the other two opposing sides of the chamber lead through the top of the arch at the ends. The slag and bullion are automatically distributed; and the vapors from the ore will be condensed in the off-take flue, means being provided to receive the metal thus condensed.

GASOLINE-LAMP.—JAMES A. YARTON, Omaha, Neb. This lamp is designed to be used in order to heat a mantle to incandescence. The lamp comprises a chamber having a gas-supply pipe entering one side, and an upwardly-curved deflecting plate in front of the opening of the pipe. A gasoline-tube extends vertically through the chamber and has perforations in its sides within the chamber. A ring supported at the upper end of the tube serves the purpose of distributing the gasoline evenly. A series of wires are suspended from the ring and within the tube, and conduct the heat down to insure the perfect volatilization of the gasoline.

INTRENCHING-TOOL.—LUTHER H. WIGHTMAN, Boston, Mass. Various tools have been designed for digging trenches, but they have been either too heavy to be conveniently carried or too small to handle sufficiently large quantities of earth. The tool provided by this invention, in order to overcome these objections, is provided with a pointed and curved body having a tang at one end. The edge of one of the sides of the body is sharpened. A hollow handle is riveted to the tang and also has a portion riveted upon the body. This tool has a weight of about one and five-eighths pounds, and has a dirt-holding or lifting surface of about thirty-four square inches.

ARTIFICIAL TOOTH CROWN AND BACKING.—CEPHAS WHITNEY, Kingston, Jamaica. The present invention provides a backing and crown for artificial teeth so constructed that the facing or porcelain, if fractured, may be readily removed and another substituted. A crown or cap is also provided which serves materially to hold the porcelain in proper position and to prevent the porcelain from chipping at its cutting edge. The backing enables a tooth to be applied to crown or bridge work in the customary manner, if it be so desired.

MICROMETER DEPTH-GAGE.—CLAUDE L. WATERS, Stamford, Conn. This micrometer gage is arranged to permit direct reading of the depth of a hole without further mental calculation and without covering up the graduations. The gage has a base capable of bearing firmly upon the object to be measured. On the base are fixed a threaded micrometer-spindle and a barrel inclosing the spindle. An indicator-sleeve screws on the spindle and slides between the barrel and the spindle.

HAT-FASTENER.—SHELDON A. STEINBARGER, Augusta, Ill. In the hat-fastener there are combined a frame on which are collars lengthwise movable, combs pivotally attached to the collars, a spring serving to draw the collars toward each other, and tapes attached to the combs, serving to move the collars outwardly and to throw the combs downwardly. When the hat is placed upon the head the combs enter the hair, and assume a horizontal position by the action of the spring, thus causing the hat to be effectually secured. By drawing the tapes outwardly the hat may be lifted from the head, the combs sliding out without injuring the hair.

ROPE-CLAMP.—LEWIS W. SAMMIS, Greenpoint, Brooklyn, New York city. The rope clamp comprises two parts—a body and a dog. The body has two separated arms provided at their outer ends with pivot-lugs extending toward each other. The dog fits between the arms of the body and has recesses receiving the pivot-lugs. One arm of the dog and the corresponding end of the body are adapted to clamp a rope between them; while the other end of the dog acts as a lever to hold the parts together, the lugs being held in engagement with the dog.

CONSTRUCTION OF METAL-CONCRETE-ARCH BRIDGES.—HOWARD V. HINCKLEY, Topeka, Kans. A novel construction in metal-concrete-arch bridges has been devised by this inventor, whereby the difficulties hitherto encountered are overcome. With the series of parallel metal I-beams extending longitudinally through the arch are connected a series of bars or clamps having integral, hooked ends clasping the longitudinal flanges of the beams. These clamps are also embedded in the concrete so that they tie the I-beams together against lateral movement. Concrete spandrel-walls are erected on the arch. Metal anchorage-frames held rigidly to the beams extend up into the spandrel-walls and support them. In order to prevent the cracking of the spandrels an expansion-joint is employed.

DISPLAY-STAND.—CLARK R. REID, Piqua, Ohio. This invention seeks to provide a means for supporting advertisements so that they can be moved around a circle. In connection with the advertisements, a concave or convex mirror is employed which is rotated with the advertisements, so that the image of the face reflected will be distorted. The mirror serves the purpose of attracting attention to the advertisements.

COMPUTING-SCALE.—WILLIAM R. DUNN, Alton, Ind. The scale has a platform actuating beams, and has, furthermore, two weights working on the beams and referring to weight and price, so that upon the proper adjustment of those weights according to the price and the desired amount of the article, the balancing of the scale will indicate that the proper amount of the commodity is on the scale.

Designs.

BEARING-PLATE FOR VEHICLES.—GEORGE W. MCCONNELL, Carrollton, Ohio. The plate has an opening provided with a horizontal lug at the top and a horizontal lug at the bottom. The opposite side of the plate has a vertical lug at each side of the opening in the plate.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS ETC.

HINTS ON AMALGAMATION AND THE GENERAL CARE OF GOLD MILLS. By W. J. Adams. Chicago: Modern Machinery Publishing Company. 1899. Illustrated. Pp. 111. Price $2.

Practical men in all parts of the world are rapidly improving mining processes, and it is necessary for those who are engaged in any mining or metallurgical pursuit to keep up with the times. It is for this reason that we welcome any book written by a practical mining engineer, like the present volume. It is a reference book of actual gold milling practice as determined by an experience of twenty years and it is written in language which can be understood by all.

SMALL ACCUMULATORS. HOW MADE AND USED. Edited by Percival Marshall. New York: Spon & Chamberlain. London: E. & F. N. Spon, Limited. 1899. Fully illustrated. Pp. 80. Price 50 cents.

The author treats briefly of the theory of the accumulator, and then describes how to make a four-volt pocket accumulator and a twelve-volt accumulator, and finally describes various types of storage batteries and gives directions for charging and using them. It appears to be a very useful little book.

SANITARY ENGINEERING OF BUILDINGS. By William Paul Gerhard. Vol. I. With 103 illustrations and 6 plates. New York: William T. Comstock. 1899. Pp. 454. Price $5.

The author is a well known sanitary engineer, and we do not know of any one who is better qualified to deal with the subject, which is of vital importance. Another volume is in active preparation, but each volume is complete in itself. Nearly every phase of modern sanitary plumbing is treated. The book is printed in large type and is well illustrated.

STEVENS' MECHANICAL CATECHISM FOR STATIONARY AND MARINE ENGINEERS, FIREMEN, ELECTRICIANS, ETC. By H. G. Stevens, M.E.E. Chicago: Laird & Lee. 1899. 18mo. Pp. 335. Price $1 and $1.50.

All of the subjects are treated in the most interesting and thorough manner and it is written in plain language. The popular question and answer system is used and there are over 240 sectional cuts and illustrations. There is a great deal of literature already on the subjects treated in this volume, but there is no question that the present work will prove useful to practical engineers and machinists and those who aspire to master these trades. One thing which we like particularly is the clear way in which many of the diagrams are lettered. The book is handsomely printed and bound.

THE ARITHMETIC OF CHEMISTRY. A Simple Treatment of the Subject of Chemical Calculations. By John Waddell. New York: The Macmillan Company. London: Macmillan & Company, Limited. 1899. Pp. 133. Price 90 cents.

Chemical arithmetic is now being taught in many colleges with the aid of a special text book, and though there are already several chemical arithmetics on the market, the present volume will certainly prove valuable. Many of the questions have been actually used in examination papers at British and American universities. The subject possesses no real difficulties when properly explained, and the volume before us will accomplish that work.

SHOE AND LEATHER REPORTER ANNUAL. New York: Shoe and Leather Reporter. 1899. Pp. 693. 8vo.

The Shoe and Leather Reporter Annual is of great value to the shoe trade, as it contains a list of all the shoe manufacturers and dealers in the United States and Canada, as well as leather dealers and manufacturers in all countries. It is evidently a great task to compile a book of this nature, and it is to be hoped that the trade will appreciate the efforts of the publishers.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION. Showing the Operations, Expenditures, and Condition of the Institution to July, 1897. Washington. 1898. Pp. 686.

The Annual Report of the Smithsonian Institution is really much more than a report, for the report proper only occupies some 80 pages of the 686. The rest is taken up by what is called "General Appendix," which furnishes brief accounts of the scientific discoveries in particular directions, including reports on the investigations made by collaborators of the Institution and memoirs of a general character or on special topics that are of interest and value to the numerous correspondents of the Institution. The articles are admirably selected and are splendidly illustrated, the whole really forming a remarkable collection of brief monographs.

THE SPIRIT OF ORGANIC CHEMISTRY. An Introduction to the Current Literature of the Subject. By Arthur Lachman, B.S., Ph.D. With an Introduction by Paul C. Freer, M.D., Ph.D. New York: The Macmillan Company. 1899. 12mo. Pp. 229. Price $1.50.

This book is intended primarily as a supplement to text books of organic chemistry. A beginner coming upon the 10,000 pages which mark the annual growth of the literature of organic chemistry cannot but be bewildered, and it is to answer the questions which naturally arise in the minds of the students that the present book has been compiled. The articles which make up this volume will be regarded as an important contribution to the history of science. It is to be regretted that organic chemistry is regarded as a labyrinthian specialty, but Prof. Lachman's book will tend to clear up many difficulties and is a contribution to the history of science as well.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

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Minerals sent for examination should be distinctly marked or labeled.

(7658) F. L. asks: 1. Can a water power be utilized economically or not for producing heat capable of steaming up a boiler, heating driers on a paper machine, or giving heat for any industrial purpose? A. We know of no mode in which a water power can be used in any direct manner for producing heat. 2. I know of paper mills which have a surplus water power which could be utilized for producing heat for their driers, thus doing away with fuel. I know that a dynamo can produce heat, but I am informed that the objections in using it for steaming a boiler are too many to be practical. I am also informed that using a current inside the driers is not practical, as the dampness of the paper will neutralize the efficiency of the current. Is that correct? A. We do not know of any instance in which electricity has been used to heat the driers of a paper machine; but we can see no reason why it cannot be used, except its cost. If it can be produced at a low figure, it can be used for any heating purpose whatsoever. 3. A dynamo can be used for producing carbide, which can be transformed into acetylene gas, with which a boiler can be made to steam. Is this practical where the water power is abundant? Will the economy in fuel derived by using said carbide warrant the cost of the installation of a carbide plant, even considering that the surplus carbide could be sold to the trade? Or will it pay better to sell the whole production of carbide to the trade, and buy coal for the boilers? You must not lose sight of the fact that I am talking of paper mills having a surplus water power, and using at present coal for heating, worth about 40 francs per ton, and using all the way from one to five tons daily. A. Water power is used for the production of most of the carbide which is made. We should think that it would be better to sell the carbide and buy coal than to use acetylene gas as fuel for heating purposes. 4. Can heat be produced with compressed air, viz., by reheating the outlet pipe of a reservoir? A. Compressed air is not an economical source of heat. 5. Do you know any other way for producing heat by means of a water power? A. No.

(7659) H. S. asks: What size of wire, B. & S., would be necessary for primaries for 500 fourwatt 16 candle power lamps, 4 miles from center of distribution, 2,200 volts on line and 10 per cent loss? A. A single phase alternate current circuit would require No. 4 wire, B. & S. gage. A three phase circuit would require No. 7 wire, B. & S. gage.

(7660) M. F. K. writes: While reading your "Notes and Queries" in the SCIENTIFIC AMERICAN I noticed that you answer fully all questions on electricity. Have you any one book from which you get this information, or any set of books? If so please name them in your reply to this letter, and also prices of same. A. There is no one book from which we obtain our answers to queries. If there were, we would not tell what it is. Of course not. Our business would be gone. Nor is there any set of books. Practical questions can only be answered from practical experience, and knowledge and books cannot give that. We have served a long apprenticeship to get it.

(7661) R. W. S. says: Please give recipe for solution which, when applied to glass, dries giving a ground glass effect. Solution does not injure the glass. A. Try the following:

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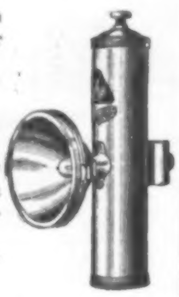

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BALL BEARING AXLES AND RUBber Tires.—A paper read before the Carriage Builders' National Convention, Philadelphia, October, 1894, showing the advantage to be derived from the use of ball bearings and pneumatic tires in road vehicles. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **992.** Price 10 cents. To be had at this office and from all newsdealers.

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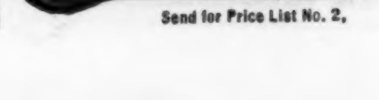

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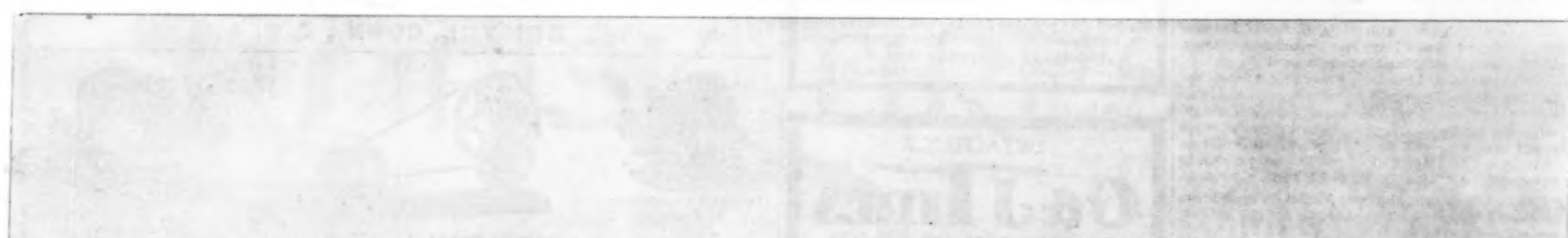

GENERAL VIEW OF THE DUNCAN COMPANY'S PLANT ON THE HUDSON RIVER AT MECHANICVILLE, N. Y.

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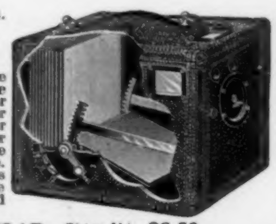

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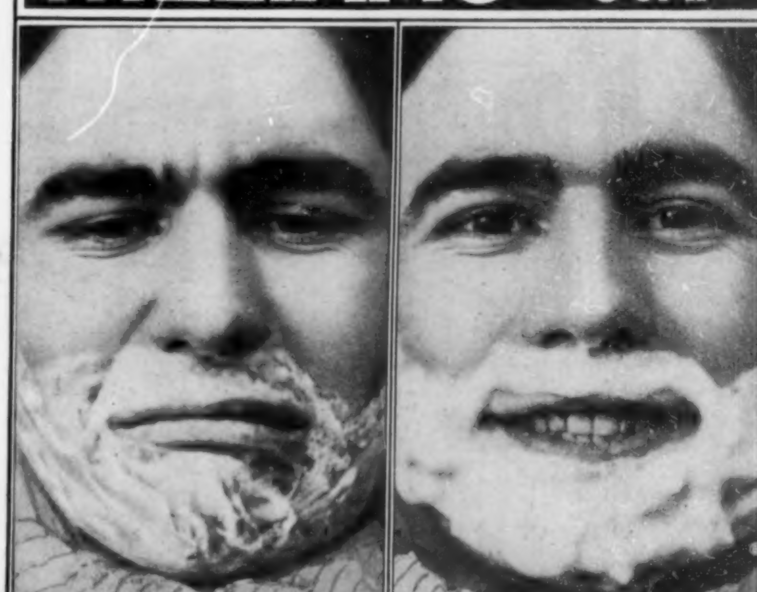

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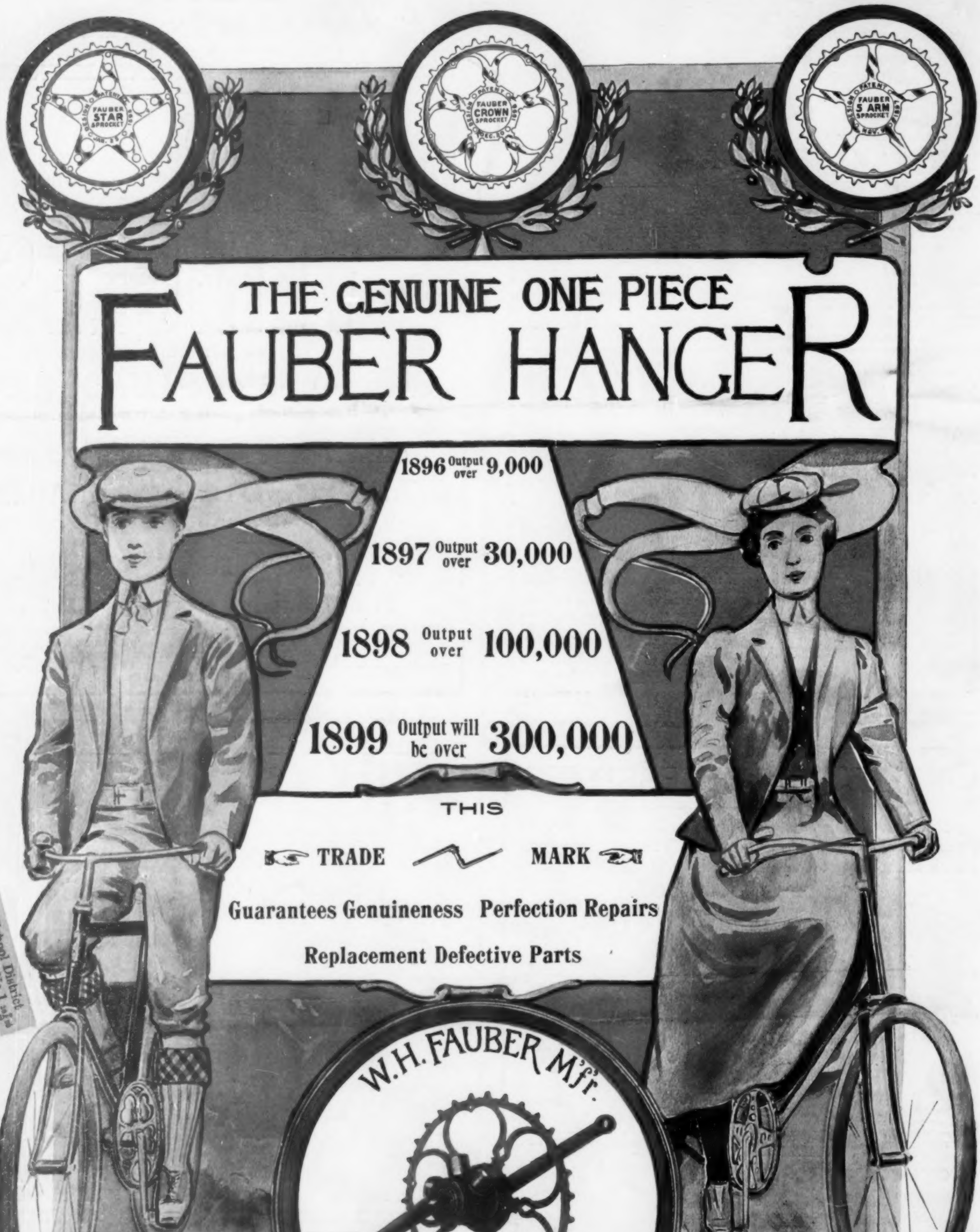
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